# Aviation Week and Space Technology

May 8, 1961


## First Details Of Yugoslavian Jet Transport Plans


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May 15-16—Region One Air Traffic Control Assn. Convention, Hotel Bradford, Boston, Mass.

May 15-16—Aviation Fire Safety Seminar and Technical Session, National Fire Protection Assn., Hilton Statler Hotel, Detroit, Mich.

May 15-17—National Symposium on Microwave Theory and Techniques, IRE, Sheraton Park Hotel, Washington, D. C.

May 15-18—20th Annual National Conference, Society of Aeronautical Weight Engineers, Sheraton Hotel, Akron, Ohio.

May 17-18—National Aerospace Standards Committee Meeting, Aerospace Industries Assn., Park Sheraton Hotel, N.Y.C.

May 22-24—National Telemetering Conference, Sheraton-Towers Hotel, Chicago, Ill.

May 22-24—Fifth National Symposium on Global Communications, Institute of Radio Engineers, Hotel Sherman, Chicago.

May 23-25—Quarterly Conference, Society of Automotive Engineers' Military Ground Support Equipment Committee, Continental Hilton Hotel, Mexico City.

May 23-25—Symposium on Large Capacity Memory Techniques for Computing Systems, Information Systems Branch—Office of Naval Research, Washington, D. C.

May 23-27—Navy League Convention and Air-Seapower Symposium, Washington.

May 26-27—First National Conference on the Peaceful Uses of Space, Tulsa, Okla. Sponsors: NASA; Tulsa Chamber of Commerce.

May 26-June 4—24th French International Air Show, Le Bourget, Paris, France.

May 27-30—13th Annual Wright Memorial Glider Meet, Soaring Society of Dayton,

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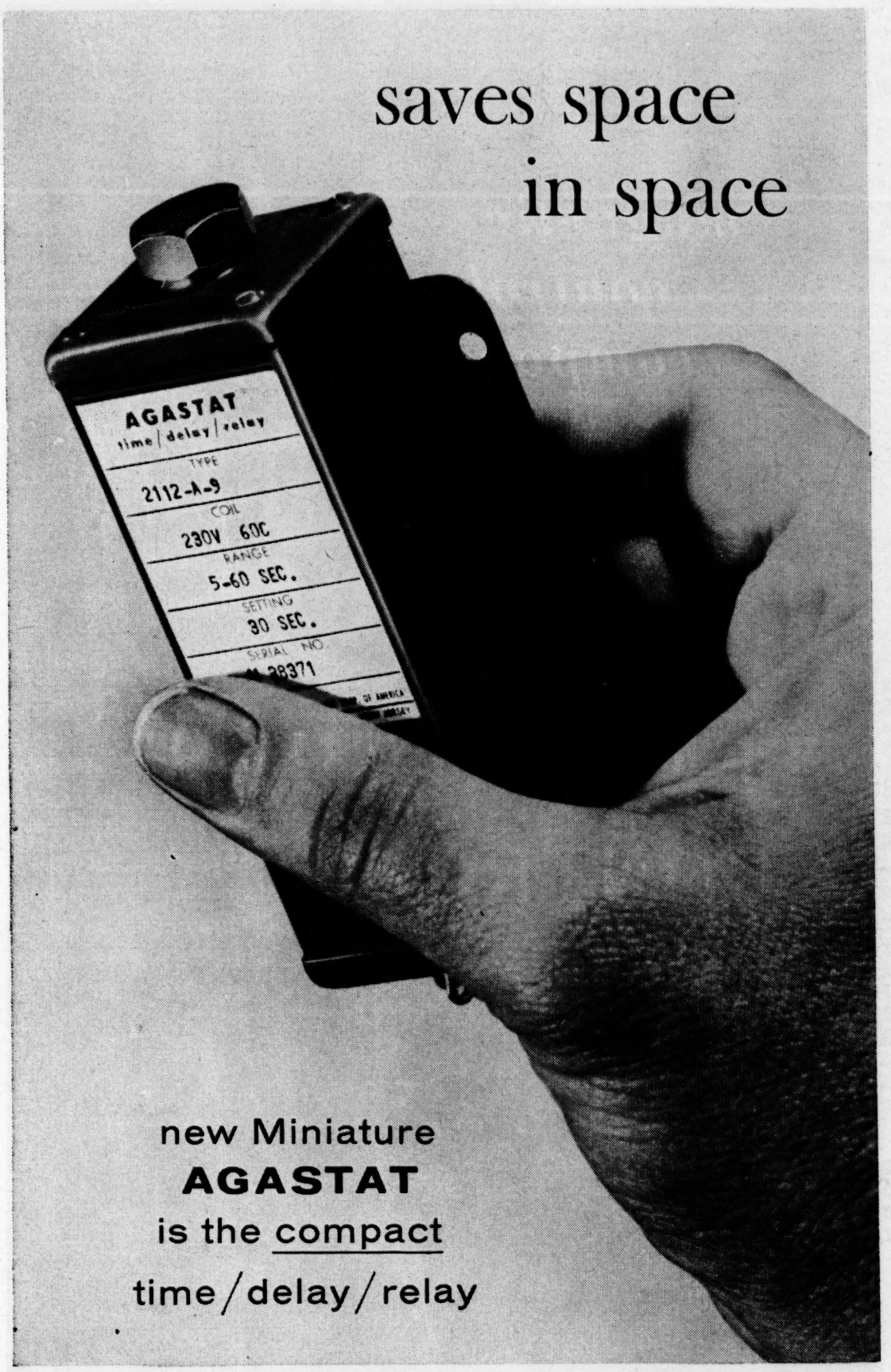


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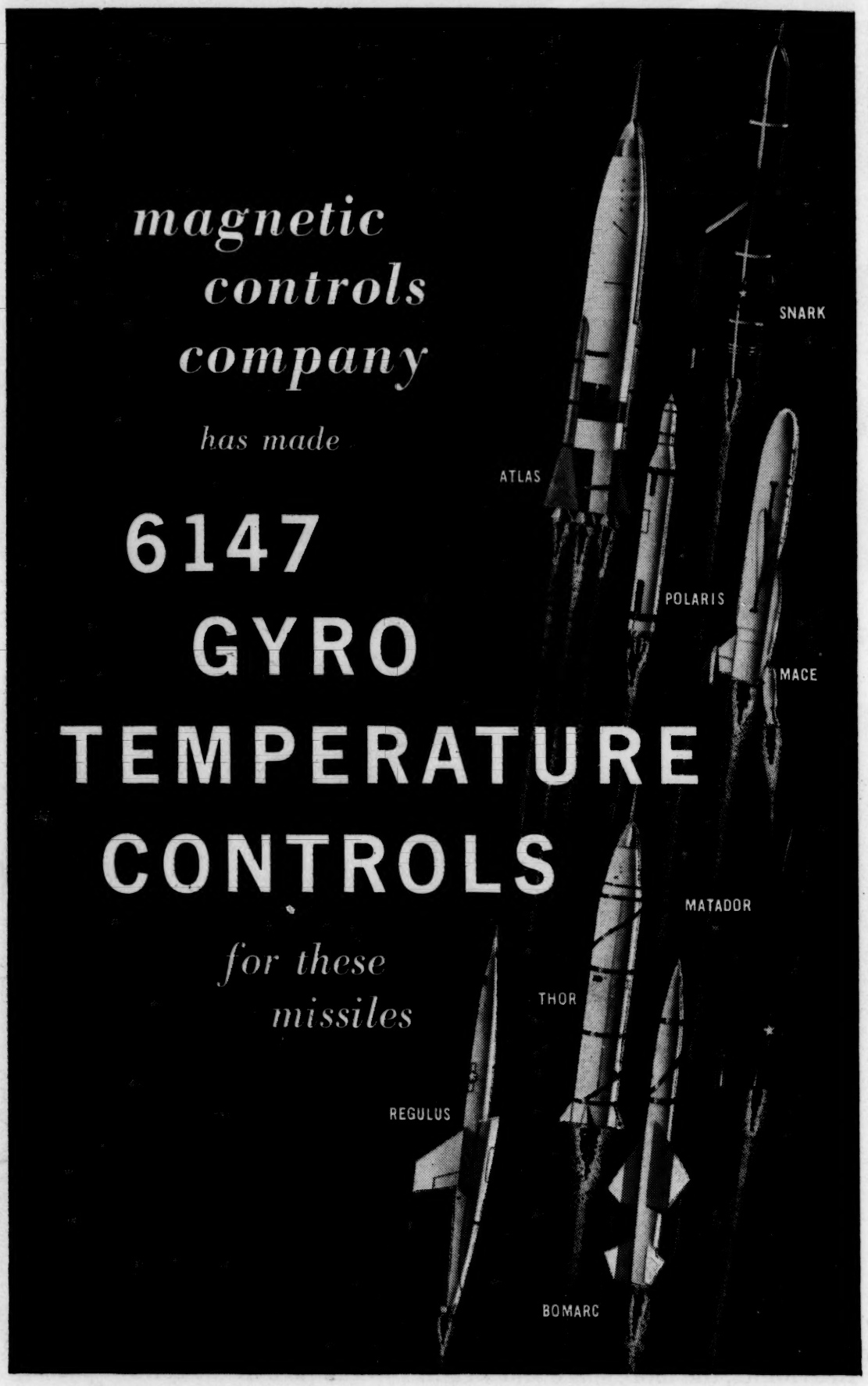


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## AVIATION CALENDAR

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Dayton, Ohio.

**May 31-June 2**—University of Michigan's Seventh Annual Radar Symposium, Ann Arbor, Mich.

**June 2-3**—12th National Maintenance and Operations Meeting, Reading Aviation Service, Inc., Reading, Pa.

**June 6-8**—International Instrument-Automation Conference & Exhibit, Instrument Society of America, Royal York Hotel, Toronto, Canada.

**June 13-15**—National Joint Meeting, Institute of the Aerospace Sciences and American Rocket Society, Ambassador Hotel, Los Angeles, Calif.

**June 13-15**—37th Meeting, Aviation Distributors and Manufacturers Assn., Dennis Hotel, Atlantic City, N. J.

**June 14-15**—Fifth Annual Conference, Product Engineering and Production, Institute of Radio Engineers, Sheraton Hotel, Philadelphia, Pa.

**June 19-21**—Space Flight and Re-entry Trajectories Symposium, International Astronautical Federation's International Academy of Astronautics, Paris, France.

**June 22-23**—Eighth Annual Symposium on Computers and Data Processing, Denver Research Institute, Elkhorn Lodge, Estes Park, Colo.

**June 26-28**—Fifth National Convention on Military Electronics, Institute of Radio Engineers, Shoreham Hotel, Washington.

**June 26-30**—Special Technical Conference, American Institute of Electrical Engineers' Aerospace Transportation Committee, Benjamin Franklin Hotel, Philadelphia.

**June 28-30**—Joint Automatic Control Conference, University of Colorado, Boulder.

**June 28-July 1**—Annual Meeting, Institute of Navigation, Williamsburg Inn, Williamsburg, Va.

**July 17**—Air Force Contract Aviation Services Symposium, National Aeronautical Services Assn., Hotel Washington, Washington, D. C.

**July 24-26**—Air Traffic Control Facilities Symposium, Electronic Maintenance Engineering Assn., Mayflower Hotel, Washington, D. C.

**July 25-Aug. 10**—International Trade Fair and Aviation Exhibition, McCormick Place Exposition Center, Chicago, Ill.

**Aug. 1-3**—Fourth Western Regional Meeting, American Astronautical Society, Sheraton-Palace Hotel, San Francisco, Calif.

**Aug. 7-9**—Guidance and Navigation Conference, American Rocket Society, Stanford University, Palo Alto, Calif.

**Aug. 22-25**—Western Electronic Show and Convention, Cow Palace, San Francisco.

**Sept. 4-10**—1961 Flying Display and Exhibition, Society of British Aircraft Constructors, Farnborough, England.

**Sept. 6-8**—National Symposium on Space Electronics and Telemetry, Institute of Radio Engineers, University of New Mexico, Albuquerque, N. M.

**Sept. 10-12**—National Convention, National Aeronautic Assn., Westbury, N. Y.

**Oct. 2-7**—12th International Astronautical Congress, Washington, D. C.

**Oct. 9-13**—American Rocket Society's 16th Annual Meeting & Space Flight Report to the Nation, Coliseum, New York, N. Y.

May 8, 1961

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EDITORIAL
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**COVER:** Egress test using a "cherry picker" crane is made in preparation for launching an astronaut on a 16-min. suborbital flight down the Atlantic Missile Range in a McDonnell Mercury capsule. This view of the Mercury-Redstone booster was taken from the blockhouse at Complex 5. Astronaut enters the capsule by riding an elevator to third level of the Redstone gantry (background) and climbing through trapezoidal hatch. Gantry is moved back in later phases of countdown, and in case of an on-the-pad abort, crane is moved quickly to capsule to rescue astronaut.

PICTURE CREDITS

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# EDITORIAL

## Mr. McNamara's Misinformation

It is difficult to make sound decisions on the basis of bad information. Therefore, it is not surprising that Defense Secretary Robert McNamara has made a monumentally unsound decision in wiping out the Aircraft Nuclear Propulsion program, because it was based on inaccurate and obsolete information spiced by a dash of deliberate distortion.

In fairness to Mr. McNamara, it must be noted that in his extremely short tenure in the Pentagon it is impossible for him to have developed expertise on all aspects of his multi-faceted job. He must, of course, rely on the validity of information submitted to him by subordinates. It is easily demonstrated that the information submitted to him for his decision on the ANP program was grossly inaccurate, technically out of date and deliberately distorted.

Some may question Mr. McNamara's executive judgment in making such a momentous decision on such a technically and militarily complex subject after such brief exposure to it. We think the case of the ANP program will provide an interesting yardstick by which to measure Mr. McNamara's intellectual integrity and his capacity for penetrating the blanket of foggy misinformation that inevitably surrounds every newly appointed civilian executive in the Pentagon's upper levels.

If Mr. McNamara fails to penetrate this fog, refuses to make the effort to get his facts first hand from the responsible technicians, and only conducts a routine bureaucratic defense of his hastily reached decisions, it will bode ill not only for ANP but for the future defense of this country.

Let us examine for accuracy the public statements of Mr. McNamara in which he says he based his decision to wipe out the Aircraft Nuclear Propulsion program:

1. He says that the Joint Chiefs of Staff have stated repeatedly since 1959 that there is no specific military requirement for a nuclear-powered aircraft. This statement is true as far as it goes, but it omits the rest of the JCS statement which said that eventual military potential of this program appeared so promising that it should be continued as a development effort aimed at early achievement of this capability. This latter point does not appear in Mr. McNamara's most recent justification of his decision, leaving the clear, if erroneous, impression that the Joint Chiefs have washed their hands of the ANP program. Actually, there has been a wide variety of specific military applications, both Navy and Air Force, for a nuclear-powered aircraft. But all of them hinged on the successful technical development of a complete nuclear-powered flying vehicle, which Mr. McNamara has now cut off.

2. He says that neither the General Electric direct cycle design nor the Pratt & Whitney indirect cycle appears to permit flight at altitudes in excess of 35,000 ft. or above subsonic speeds. This altitude figure, along with the frequently quoted Mach 0.8 speed barrier, were never meant to be technical limitations on the nuclear powerplant. They are simply the performance specifications laid down by Herbert York, former Defense director of research and engineering, to be met by the initial nuclear-powered aircraft. Both GE and P&W have actually designed supersonic applications of their respective nuclear cycles, and no responsible technician in this field would support Mr. McNamara's performance limitation figures. He can, if he is so inclined, easily trace their correct genealogy.

3. He says that the GE direct cycle engine would exhaust fission products into the atmosphere during takeoff, landing and normal flight, making it unlikely that the aircraft could operate from normal commercial or military airfields. The problem of fissionable exhaust products from the direct cycle engine can be eliminated both through operational procedures (i.e., using conventional jet fuel for landing and takeoff) and by technical solutions already determined feasible (i.e., treatment of the fission products before they exhaust into the atmosphere). Even without these methods, however, the fission products exhausting from the direct cycle engine were calculated to be so negligible that more than 50 such aircraft could operate from a single field without creating radiation hazards exceeding the Atomic Energy Commission permissible standards.

4. He says that the P&W indirect cycle has 15 mi. of tubing carrying molten metal at temperatures up to 2,000F and uses 26,000 welded joints, so that a leak would constitute a severe hazard. These figures are about 4 yr. old and no longer accurate. But the important point is that Mr. McNamara apparently does not understand that both USAF and the commercial airlines are operating B-52 and 707 type aircraft safely every day with many miles of tubing carrying fuel, oil, hydraulic fluid and electricity—a leak in any one of which could be and has been hazardous to the aircraft and its occupants. Actually, the problem of countering the hazard of leaks in the indirect cycle system has been solved technically, as Mr. McNamara could easily determine by talking with the men who have done it.

5. He says that the GE-proposed B-52 flying test bed rigged with two nuclear-powered direct cycle engines could not be flown on nuclear power alone; that it has no technical value in the development program, and that it is simply a stunt. This will shock every engineer and military man who has been even remotely familiar with aircraft powerplant development for the past two decades. First, the statement is inaccurate because even one of the two nuclear-powered engines proposed would sustain the B-52 in flight at medium altitude, and both could certainly fly it with ease. This is hardly the point of a flying test bed rig for a new powerplant, as any propulsion engineer can readily testify.

Mr. McNamara indicates he completely misses the point that, far from being a "stunt," this flying test bed is a vital step in the technical development process of any new powerplant and has been a standard technique in jet engine development for 20 yr. We suggest he consult some of the senior Naval aviators and Westinghouse and McDonnell engineers on the first and last time they attempted to mate a new jet engine with a new air-

# On Aircraft Nuclear Propulsion

frame without prior flying test bed time on the new engine. Like his Pentagon predecessor from Detroit, Charles Wilson, who ridiculed the 1952 proposal for a B-36 test bed for nuclear powerplants as a "shitepoke," Mr. McNamara simply does not understand the technique or significance of a flying test bed in new engine development cycles.

6. He says that cancellation of the ANP program does not mean discontinuance of research on high performance reactors because this work will continue under AEC. Actually, the AEC work authorized in this area under the Fiscal 1962 budget has no specific orientation toward a useful aircraft application. It will operate at a small fraction of the previous program level and will mean the dissipation beyond any hope of future recovery of the several thousand engineers and technicians who, until Mr. McNamara's decision, represented the sole U.S. resource in this vital field.

A more detailed annotation of Mr. McNamara's public statements on ANP than is possible in this space would produce even more basic errors of fact. But even worse than this inaccurate information now being dispensed as gospel is the basically fallacious concept of the Aircraft Nuclear Propulsion program, which Mr. McNamara apparently believes, as 15 yr. of wasted effort producing nothing but a billion dollar drain of taxpayers' money. Even a moderate amount of historical study on this subject would destroy this dangerous myth, which is a gross libel on the technical capabilities of the engineers and technicians who worked in this field.

The first five of these post-war years were spent in feasibility studies under the NEPA and Lexington projects. By 1951, both groups of learned gentlemen involved reached the same conclusion—that nuclear propulsion could be successfully used in aircraft and a program toward achieving this goal should be organized.

The technical development of ANP hardware got under way in 1952. For the next eight years, it developed into a classic case of how political and executive incompetence can frustrate technical progress. Three times in this period the entire ANP program was canceled, and four times it was completely reoriented and aimed in widely divergent directions. With this sort of topside management and direction, it would not be surprising if little technical progress resulted.

The fact is, however, that despite this incredible vacillation, fund chopping and lack of clearly defined technical goals, the engineers and scientists working in the ANP field made truly remarkable progress—particularly in the past two years when the program achieved the type of technical momentum that usually heralds eventual success.

The ANP effort advanced reactor technique far beyond its previous frontiers and produced developments that will have wide application in many areas outside the aircraft field, such as remote power stations and marine reactors. It solved the basic problems of packaging reactors in small enough units to be employed in aircraft, of adequately shielding aircraft crew and equipment, and of operating the other subsystems required in a flying vehicle in the environment of radiation. It achieved potential engine life of 1,000 hr. continuous operation at full power with endurance of from 5,000 to 10,000 hr. continuous operation at normal cruising power. And it flattened the annoying nuclear power variation curve to a mere 6% from the previous standard of about 30%.

In all the eight years of active work on ANP hardware, the prospects for successfully developing a militarily useful nuclear-powered aircraft were never so technically bright as just before the decision was made by Mr. McNamara to wash its achievements down the drain.

Perhaps the basic management mistake was requiring development of a vehicle to meet specific military requirements before basic engineering and operational feasibility of a full scale flying system was achieved. As each new technical milestone was reached, additional military requirements were loaded onto the program—enough to make it founder from this cause alone.

Some of the Pentagon experts who kicked the ANP program around had a philosophy that would have demanded that the Wright brothers be required to solve the problems of supersonic flight before they should be allowed to launch their machine at Kitty Hawk. None of these people are now publicly visible in the ANP debacle, and it is Mr. McNamara who will take the credit or blame for this decision in the pages of history.

It is interesting to note that none of the Pentagon technical experts who are undoubtedly the source of Mr. McNamara's misinformation were available to testify recently before the Joint Congressional Committee on Atomic Energy when it tried to probe into the ANP cancellation. The underling witness who was finally sent from the Pentagon to this hearing convinced his congressional listeners only of his incompetence to discuss the subject at issue.

Cancellation of the ANP program will cut far deeper than the immediate effects on the three contractors involved in the two engine programs and the NX-2 airframe development. This decision arbitrarily shuts the door on a basic new source of power for aerial vehicles of many types, including some completely unforeseen now, and it falsely proclaims to the world that we have failed technically in another field where the Soviet Union is certain to publicly demonstrate its success soon.

But the most tragic aspect of the ANP cancellation is the amount of basically inaccurate and erroneous data on which it was based and the demonstration that there is apparently no opportunity for technical facts to be pumped into the government's highest decision-making levels.

The epitaph now being carved on the tombstone of the ANP program may well be the same as that engraved on our tombstone as a nation if we fail to develop a better system of technical management in our government that will permit the full potential of our technical and industrial resources to be marshalled to meet the challenge of our times.

**—Robert Hotz**

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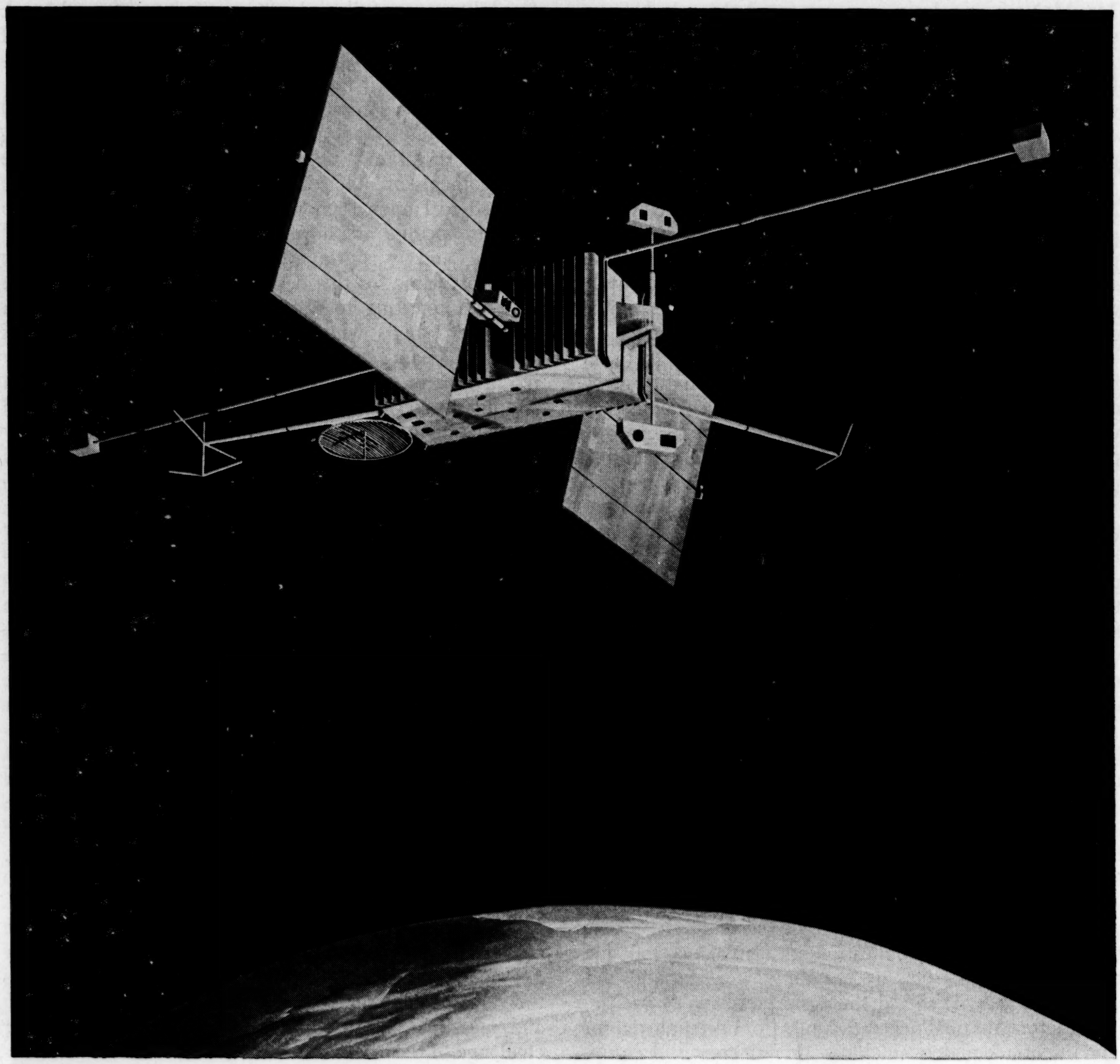

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**Frederick E. Hines,** formerly Douglas Aircraft Co.'s vice president-finance, a director of Electronic Engineering Co. of California, Santa Ana, Calif.

**Keith T. Middleton,** president, the Fafnir Bearing Co., New Britain, Conn., succeeding **Clarence G. Rosensweig,** now vice chairman of the board.

**Dr. Alden H. Ryan,** president of the newly established Electromagnetic Technology Corp., Palo Alto, Calif. Also: **Dr. William A. Edson,** vice president and director of research; **Fred W. Morris, Jr.,** executive vice president.

**Frederick J. Seufert,** president, U. S. Science Corp., Los Angeles, Calif., succeeding **L. D. Rexroat,** resigned.

**John H. Humphrey,** executive vice president, Dashew Business Machines, Inc., Los Angeles, Calif.

**Richard B. Leng,** executive vice-president, Quantatron, Inc., Santa Monica, Calif.

Kearfott Division of General Precision, Inc., Little Falls, N. J., has announced the following appointments: **Robert F. Ward,** group vice president-precision components operations: **Joseph B. Heimann,** group vice president-avionics group; **Thomas J. Thomas,** vice president-computer and controls and power equipment.

**Dr. Nicholas A. Begovich,** vice president, Hughes Aircraft Co., Culver City, Calif. Dr. Begovich continues as assistant manager-ground systems group and director-product line operations at Hughes-Fullerton.

**R. L. Beam,** executive vice president, Hazeltine Corp., Little Neck, N. Y. Mr. Beam continues as executive vice president and operating head of Hazeltine Electronics Division.

**Ervin J. Osterhus,** executive vice president, and **Walter J. Hood,** vice president-engineering, Designers for Industry, Inc., Cleveland, Ohio.

The Bendix Corp., Detroit, Mich., has elected **Dr. R. D. O'Neal,** vice president-engineering, and **R. H. Isaacs,** vice president-government relations, to the company's administration committee.

**J. M. Bridgman,** vice president and general manager, Litton Systems (Canada) Ltd., Rexdale, Canada.

**Jerome D. Kennedy,** executive vice president and general manager, Applied Dynamics, Inc., Ann Arbor, Mich.

**Rollin M. Russell,** executive vice president and a director, Acoustica Associates, Inc., Los Angeles, Calif.

**Myron Newberger,** executive vice president, Avnet Corp., Los Angeles, Calif., a subsidiary of Avnet Electronics Corp. Also: **Daniel J. D'Addario,** general manager of Avnet Electronics' East Coast operations, Westbury, N. Y.

**Walter C. Scott,** head-Space Power Technology Projects, Office of Space Flight Programs, National Aeronautics and Space Administration, Washington, D. C.

(*Continued on page 127*)

# INDUSTRY OBSERVER

▶Joint proposal is being submitted by Space Technology Laboratories, Hughes Aircraft Corp. and Grumman Aircraft Engineering Corp. in the Project Prospector mobile lunar vehicle competition conducted by NASA's Jet Propulsion Laboratory. STL would have over-all design and integration responsibility, Hughes would design the spacecraft and Grumman would design the mobile vehicle for use on the moon's surface.

**▶Navy probably will initiate a design competition for a new generation of anti-submarine warfare aircraft early next year. A number of aircraft configurations, including seaplanes, will be evaluated, and provision for integration of ASW equipment will be emphasized.**

▶Research and development is being pushed on maneuverable re-entry vehicles carrying warheads for intercontinental ballistic missile application. They would add to the diversion aspects introduced in warhead terminal flight phase by decoys and electronic countermeasures.

**▶Army has successfully fired a high-altitude target missile called Upstart from White Sands Missile Range. Built by Aeronca, the vehicle is designed for vertical firing and parachute recovery (AW June 20, 1960, p. 295).**

▶Navy is interested in a television-guided air-to-surface missile but isn't enthusiastic about Martin Orlando Division's White Lance TV missile, derived from Bullpup, because it must be followed relatively close to the target by the launching aircraft. Navy wants a missile that could be launched at a good distance, then directed to the target by the pilot with a visual cockpit display as the aircraft made its escape.

**▶NASA's Goddard Space Flight Center is planning a series of sounding rocket firings under Project Skylark to survey the southern sky. Four payloads currently are planned for these experiments.**

▶General Dynamics' Electric Boat Division has been selected to study feasibility of designing and building submarine electronics equipment as a single integrated system instead of the present patchwork of systems and components. Raytheon is major subcontractor to General Dynamics in the Navy Bureau of Ships program.

**▶Precision infrared spotter under study at Naval Ordnance Laboratory is planned for automatic acquisition and tracking of targets at altitudes up to 75,000 ft. Similar precision infrared system is under USAF development.**

▶Lockheed Agena B stage is undergoing static and other test phases in preparation for the launching of National Aeronautics and Space Administration's first Ranger test flight, to be launched with an Atlas-Agena in July.

**▶Soviet scientists have shown interest in the idea of using the plasma surrounding a re-entering spacecraft to help decelerate it, a concept also being explored in the U. S. Meteors composed of electrically conductive matter experience a sharp deceleration greatly exceeding that explainable in terms of known aerodynamic drag formulas, but if the meteors are rotating their speed may remain constant or accelerate since the plasma encounters less pressure, according to Prof. G. I. Pokrovsky.**

▶Contractors for the tri-service VTOL transport and Army's light observation helicopter (LOH) program are expected to be chosen next week. Lockheed is seriously considering going ahead with development of a civil four-place light helicopter based on its LOH entry whether it wins the competition or not.

**▶Project Apollo, three-man spacecraft, now is divided into two phases—Apollo A, an earth-orbiting vehicle, and Apollo B, designed for lunar orbit.**

▶Boeing 707 prototype is being modified by adding a fifth engine position, including intake, at the rear of the fuselage to simulate the center engine in the 727 layout.

# SILICOLOGY

## *Studies in Silicones*

**HOW THESE TIME-TESTED MATERIALS CAN WORK FOR YOU**

# New Silicone Rubber Compounds Now Can Be Molded to Closest Tolerances

Looking for durable rubber compounds that offer precision molding, reliability, and flexibility over a wide temperature range—where other materials have failed?

Here is one example of how silicone rubber compounds came into existence to fill these requirements, through cooperation between Silicones Division engineers and their customers.

Sierra Engineering Company, Sierra Madre, Calif., had a new emergency oxygen mask under development for passengers on today's high-altitude, high-speed jet airliners. They needed a rubber material with these properties:

1. Resiliency to spring back to shape after folded storage.
2. Softness to conform to facial contours.
3. Extremely low oxygen permeability.
4. Good color dispersion.
5. Non-irritating, non-allergenic properties.
6. No smoke or fume problems during post-cure.

## COOPERATIVE ENGINEERING

The Union Carbide Silicones Man brought these and other requirements back to his team of associates in R&D.

Prior to this, the combined technical and research facilities of Union Carbide Corporation, with tremendous resources of chemical experience and knowledge, had already achieved a long list of "firsts" in silicone rubber, including:

A controlled reactivity, vinyl-containing silicone rubber. A non-volatile catalyst system for one-step curing of thick sections. Electrically conductive silicone rubber. A rubber for electrical tapes, hot-air ducting, and other wrapped constructions. A compound to meet Naval cable specifications for atomic submarines. And the first and only silicone rubber compound qualified for automotive rear pinion seals.

**FROM UNION CARBIDE**—first commercial silicone compound for high-altitude emergency oxygen masks.

**SIERRA ENGINEERING COMPANY** of Sierra Madre, Calif., tests every silicone rubber mask it manufactures and maintains an accurate serial number check to be sure the quality is uniform at all times.

## MEETING BASIC PRODUCTION PROBLEMS

For Sierra's oxygen masks, the principal properties needed had all been met before, *but not in a single silicone rubber compound.* Working closely with Sierra, engineers of the Silicones Division succeeded in formulating a compound that matched the needs and answered all basic production problems as well.

The new compound permits molding to extremely close tolerances. Its purity means freedom from smoke and fume problems during post-cure. It more than meets Sierra's strict quality controls, including complete performance test records on every mask produced. And the same compound is now also being used for Sierra's oxygen masks designed for military jet pilots and the crews of commercial planes.

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If your designing calls for rubber with advantages such as low temperature flexibility, thermal and oxidation stability at very high temperatures, low compression set, weather, ozone, oil resistance, electrical resistance or conductivity, your Silicones Man has them at his finger tips. The coupon below will bring your problems to his immediate attention.

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# Washington Roundup

## Rover Backup

**Possibility of a backup program for the Rover nuclear rocket has been raised as Congress and the executive branch** of government cast around for ways to accelerate the development of space propulsion systems.

**House Science and Astronautics Committee, which held five days of public hearings on the Rover program** only two months ago, will reopen the whole subject of nuclear power for space vehicles at new hearings expected to be held within two months.

**Both industry and government witnesses will be called. At least eight firms—those which bid on Nerva,** the first Rover flight engine (AW Apr. 10, p. 33)—are expected to testify. The Nerva contract is due to be awarded next month.

**Several companies will argue for a backup program, using different approaches, on the grounds** that National Aeronautics and Space Administration should not limit such a potentially important propulsion system to one project.

**Committee Chairman Overton Brooks told Aviation Week he does not advocate a backup program at this time because his first concern is to get sufficient money for Rover.** His committee last week added $23.5 million for Rover to NASA's budget authorization (see p. 27). Suggestion for another nuclear rocket project is being considered at high levels in the executive branch as part of the current review of the space program.

**John J. McCloy, President Kennedy's disarmament adviser, is ready to present recommendations to the President this week on legislation to establish an arms control organization** within the government. Meanwhile, the Administration still is working against a July 31 deadline in drafting its proposals. This is the date agreed on by the U. S. and the USSR for the resumption of disarmament negotiations. In its studies, McCloy's office is including proposals for unilateral actions that the U. S. might take on control of arms.

## Grilling CIA

**Central Intelligence Agency's activities are in for at least two reviews ordered by the White House and possibly for further congressional scrutiny** as a result of its participation in the abortive Cuban "invasion" and accusations that it encouraged the short-lived revolt of French generals against President Charles de Gaulle.

**Dr. James R. Killian, Jr., chairman of Massachusetts Institute of Technology and the man whom former President Eisenhower chose as the first presidential science adviser** shortly after Sputnik I was launched, has been asked by President Kennedy to head a reconstituted board of consultants on foreign intelligence activities. Its duties are continuing and are separate from the more limited study of para-military operations headed by Army Gen. Maxwell Taylor (AW May 1, p. 28).

**Others on the board are Gen. Taylor, retired USAF Lt. Gen. James H. Doolittle, chairman of Space Technology Laboratories; Dr. William O. Baker,** vice president for research at Bell Telephone Labs; former Under Secretary of State Robert D. Murphy, now president of Corning Glass International, and Dr. William L. Langer, Harvard history professor. The board is to report periodically on CIA and other intelligence agencies.

**Senate Democratic Whip Hubert Humphrey says Congress probably will have to oversee CIA's activities through a joint watchdog committee** unless the Administration makes some changes. There is strong congressional sentiment for getting CIA out of the "black" intelligence, or operating fields.

## KLM Route Attacked

**Congressional silence on President Kennedy's decision to give KLM, the Dutch airline, a route to Los Angeles, was broken by an unusually strong attack** from the President's close friend, Sen. George Smathers. The Florida Democrat denounced State Department's handling of bilateral air agreements with foreign nations and was particularly critical of the methods used by The Netherlands—visits by the Dutch ambassador with State Department officials and personal talks between the Dutch foreign minister and the President.

**Sen. Smathers warned that approval of the KLM route seems to indicate that the U. S. will yield** to "any high pressure campaign" for the awarding of routes and that other foreign governments may adopt the same approach if the KLM decision stands.

**Proposed tax on jet fuels appears to have a better chance of passage this year than at any time in the past.** As airlines use more jet fuel and less regular aviation gas, which is taxed, the tax base decreases and discrimination against those who use regular gas becomes more apparent.

**Richard S. Morse is resigning as Army assistant secretary for research and development.** Successor had not been finally decided upon late last week. **—Washington Staff**

# House Committee Adds Bombers to Budget

## Armed services group authorizes $337 million extra for B-52 or B-58, fails to increase B-70 program.

By Katherine Johnsen

**Washington**—House Armed Services Committee voted unanimously last week to authorize an extra $337 million to continue production of current strategic bombers, but the group refused to heed Air Force pleas for more money to develop the B-70 as the next strategic manned weapon system.

The House committee, headed by Rep. Carl Vinson (D.-Ga.), authorized Fiscal 1962 funds to continue production of the Boeing B-52 or Convair B-58 or both. The choice was left to the Air Force. No production money was included for these bombers in the Administration's budget.

The Administration's decision to cut the B-70 back to an aircraft flight test program was accepted by the committee. The controversial program now moves to the House floor and to the Senate, where the Air Force has been campaigning for restoration of the B-70 as a full weapon system development effort.

The bomber change was the major action taken by the group in approving legislation authorizing $12.4 billion for procurement of aircraft, missiles and ships by the three military services in Fiscal 1962. This is $393 million more than proposed by the Kennedy Administration and $1.8 billion more than proposed by the Eisenhower Administration.

The allocations for aircraft are: Air Force, $3.7 billion; Navy and Marine Corps, $1.6 billion; Army, $211 million.

For missiles, the allocations are: Air Force, $2.8 billion; Navy, $607 million; Marine Corps, $27 million; Army, $551 million.

The funds in the authorization measure have to be implemented by appropriations, which are under the jurisdiction of the House and Senate Appropriations Committees. However, funds now cannot be appropriated for aircraft and missile procurement unless they have first been authorized by the Armed Services committees.

In addition to the funds for strategic bombers, the House committee voted these increases in the Administration budget (AW Apr. 3 p. 26):

• **Turbofan engines, $21.2 million.** This will provide for turbofan, instead of turbojet, engines in 15 of the 30 Boeing C-135 cargo aircraft for Military Air Transport Service that are funded with $117 million in the Administration budget.

• **Special mission aircraft,** $25 million. This will purchase three long-range jet passenger transports, such as the Boeing VC-137A, Douglas DC-8 or Convair 990, for executive use. Comments by Soviet Premier Nikita Khrushchev on the ability of Russian officials to make international flights nonstop have reached and annoyed members of Congress.

• **Guided missile frigates,** $10 million. This will replace three conventional ships in the Administration program with two nuclear-powered types, reducing the total from seven to six ships.

The Vinson committee endorsed the Administration on the two programs that have provoked the most controversy in the Senate—the B-70 bomber program and the Army's Nike-Zeus anti-missile missile program. There was no support in the committee for additional funds to move Nike-Zeus into the production phase, and small support for increased B-70 funds. The Kennedy Administration reduced the $358-million proposed by the Eisenhower Administration to $220 million.

"This cut in the B-70 program caused the committee some concern at first, but we found that the Kennedy program will permit an orderly development of the B-70, and will provide an opportunity to find out a great many things about the B-70 which must be known before the final decision on its complete development can be made," Rep. Vinson explained.

Senate Armed Services Committee, headed by Sen. Richard Russell (D.-Ga.), is scheduled to vote on legislation authorizing missile and aircraft procurement this week. The measure approved last week by the House Armed Services Committee will be brought to the House floor for action May 15 or 16, Rep. Vinson estimated.

The House committee arrived at the $337-million figure for strategic bombers by adding the cost of 15 B-52s and 16 B-58s, or about a third of a wing of each aircraft. The group considered this the most impartial manner in which to get a figure to include in legislation. Rep. Vinson emphasized that it is no indication that the committee favors this 50-50 mix.

"We simply want bombers—the Air Force can decide what kind," he said. "Particularly, we do not want to put all our eggs in one basket until missiles are completely proven."

Neither the Eisenhower nor the Kennedy Fiscal 1962 budgets had funds for more B-52s or B-58s. The B-52 production line is scheduled to close in August, 1962, and the B-58 line in October, 1962. B-52 output is now at a rate of six per month, and B-58 output at four a month.

"While it may well be true that the intercontinental ballistic missile may at some time in the future provide our principal means of deterrence and our greatest offensive capability, that time has not come as yet," Rep. Vinson said. "The committee was unanimous in its belief that this country needs the proper mix of missiles and bombers.

"After all, the missile can do only one of two things: it can go or it can not go. A bomber, on the other hand, has an almost infinite variety of capabilities. It can carry all kinds of weapons, it can proceed and be recalled, it can go a certain distance and wait for a further command, it can perform reconnaissance; it can do just about anything."

Pointing out that reappraisal of the defense posture by Secretary of Defense Robert S. McNamara "is only in a preliminary stage at this time," Rep. Vinson observed: "I just wonder whether Mr. McNamara will not arrive at the same conclusion that the committee did that we should keep the bomber assembly lines going. Everybody knows that if we stop the line, it will cost us a great deal of money to get it started again, and we don't get very much for the money spent in starting it up in the way of actual aircraft."

### Project Phoenix Study

**Initial report on Project Phoenix low-cost launch system Phase II study by Air Force's Space Systems Division, Aerospace Corp., and Rand Corp., was submitted May 1 to Air Force's Systems Command, after which it will be considered by USAF HQ and Dept. of Defense. Project is expected to be funded and estimate is that the over-all program may require about $3 billion. Firm decision on implementation of the program probably will be made in less than three months.**

**Likelihood is that one of the vehicles expected to be used most in the low-cost launch scheme is a two-stage configuration consisting of a solid propellant booster developing 480,000 lb. thrust and a liquid hydrogen/liquid oxygen second stage developing 200,000 lb. thrust (AW, Mar. 27, p. 50).**

## Saturn Tank Bids

Eight companies have been asked to bid on fabrication of six 105-in. diameter cylindrical liquid oxygen tanks for Saturn flight test vehicles. Pre-proposal conference was held last week at Marshall Space Flight Center and proposals are due by June 1, with production to begin by April of next year.

Boeing, Chance Vought, Chrysler, Douglas, Lockheed, Martin, McDonnell and North American were invited to the conference. The 675-in. long cylinders are to be fabricated from aluminum alloy sheets with rigid wall design. Each Saturn booster uses one 105-in. diameter tank adapted from the Jupiter missile surrounded by eight 70-in. diameter tanks adapted from the Redstone missile to hold propellants. The 105-in. tank and four of the smaller ones hold liquid oxygen, and the remaining smaller ones hold kerosene.

Tanks for initial Saturn static and flight test vehicles were fabricated at Marshall. Evaluation will stress rigidity, reliability, quality assurance, testing and processing procedures.

## Bell Signs Contracts With Union Locals

Separate three-year contracts with Bell Aerosystems Co. were ratified last week by members of UAW Locals 501 and 516.

Under the contracts, which run from May 1, 1961 to Apr. 30, 1964, annual five cent an hour increases will be granted to members of the two locals during each of the last two years of the contract. The locals represent Bell's production and maintenance workers, timekeepers, inspectors, accounting personnel and firemen (AW Apr. 24, p. 34).

The 1961 wages continue at the present rate for the first year of the contracts which do not contain a wage or other fringe benefit reopening clause. Increases of 5 cents an hour are provided for on Apr. 30, 1962, and Apr. 29, 1963.

Bell President William G. Gisel expressed complete satisfaction with the acceptance of the contracts which he said would definitely improve the competitive position of the company.

The contracts also provide that 3 cents of the current 5 cents an hour cost-of-living "float" will be added to all base hourly rates. This will place the cost-of-living float at 2 cents per hour.

In addition to the wage increases, the contracts provide that local members with 20 years or more seniority will receive three weeks actual vacation time but they will be paid for four weeks vacation.

# Key NASA Budget Cuts Restored As House Group Cites 'Urgency'

By George C. Wilson

**Washington**—House Science and Astronautics Committee last week authorized far more money than President Kennedy requested for such key National Aeronautics and Space Administration programs as Apollo, Rover and solid propulsion research.

Chairman Overton Brooks (D.-La.) said the reason for going beyond the President's requests—and in a few cases even beyond NASA's requests—was to create "a sense of urgency" about the nation's space effort.

The extra money authorized will not be appropriated unless the House and Senate appropriations committees give their approval. Those committees usually stick close to the amounts approved by the Bureau of the Budget.

But there is growing evidence that President Kennedy, in contrast to his predecessor, looks upon the space effort as a race with Russia witnessed by the whole world, and that he might be more favorable toward increased space funds than he was when his requested changes in the Eisenhower budget were sent to Capitol Hill several weeks ago.

This changing White House attitude is being communicated directly to congressional leaders by Vice President Johnson, chairman of the National Aeronautics and Space Council. Mr. Johnson met last week with Chairman Robert S. Kerr (D.-Okla.) and Sen. Styles Bridges (R.-N. H.), ranking minority member of the Senate Aeronautical and Space Sciences Committee, to review the space program.

This was the first meeting Vice President Johnson had held with congressional space leaders since becoming head of the council. A larger meeting, scheduled for May 1 and involving the President, Vice President, heads of the House and Senate space committees, the President's science adviser and others, was postponed (AW May 1, p. 25).

The growing interest of the Kennedy Administration in the space program could lead to some further requests for budget increases, though most likely not as great as these authorized by the House space committee for R&D work by NASA in Fiscal 1962:

• **Apollo.** Increased from the $29.5 million approved by the Budget Bureau to $72.1 million—the amount requested by NASA during the Kennedy review of the Eisenhower budget. The restoration, according to NASA, would speed up the development of the three-man vehicle and provide money for flight testing. NASA wants to determine the best design and materials for a spacecraft that will have to re-enter the earth's atmosphere at 25,000 mph.

In addition to these research and development increases, the committee authorized an additional $5 million for construction and $2.6 million for staffing. The committee's total increases for Apollo came to $50.2 million.

• **Project Rover.** Increased from $17.5 million approved by the Budget Bureau to $26 million—an increase of $8.5 million and the amount NASA requested. The committee also authorized an additional $15 million for construction of test facilities for engines.

• **Solid propulsion.** Increased from $3.1 million requested by the Budget Bureau to $18.1 million, almost six times what President Kennedy requested and more than double the $8.1 million sought by NASA in its amended requests.

Rep. David S. King (D.-Utah) sought during the committee mark-up of the bill to increase the solid propellant authorization to $50 million. He argued there was not enough diversification in the propulsion program, and said there should be more federal encouragement of solid rocket clustering techniques rather than just of segmented solid rocket approaches.

The King motion failed, but a substitute motion by Rep. James G. Fulton (D.-Pa.), calling for the $18.1-million authorization, passed.

Although the majority of the House committee obviously felt more dollars might buy more success in space, there was some dissent to this approach. For example, Rep. William K. Van Pelt of Wisconsin, ranking Republican on the House Space Science Research and Development Subcommittee, said authorizing more dollars than the Budget Bureau requested was setting "an undesirable precedent."

Emphasizing that he wanted to give NASA all the support it needed, Van Pelt said he felt that before the committee authorized more money than the Budget Bureau and NASA requested, it should recall NASA witnesses before the committee to justify the increases. He added that NASA will have to justify any increases authorized once the bill goes before the appropriations committees.

Late in the week, NASA witnesses including Deputy Administrator Hugh Dryden were recalled to explain how they would use additional life sciences funds if any were added. NASA said it hoped to use Mercury capsules to put animals into orbit for as long as 14 days.

# Joint Fighter Program to Include Current Aircraft, Two New Types

**Washington**—Defense Department report on the tri-service tactical fighter program is expected next week to recommend interim procurement of one slightly modified current aircraft and development of two completely new airplanes.

Immediate needs for Air Force Tactical Air Command close support of the Army will be filled through reprograming of Fiscal 1961 funds and a portion of the additional Fiscal 1962 funds requested by the Kennedy Administration. The moves reflect President Kennedy's emphasis on limited war capabilities (AW Apr. 17, p. 29 and May 1, p. 25).

Eleven TAC squadrons operating 300 aircraft of a type the Army will choose will remain active instead of being phased out as previously planned. They will be equipped with the interim fighter. Army favors Navy-Douglas A4D.

A Department of Defense committee, which was given the task of making the tactical fighter recommendations, this week is combining results of visits to aircraft manufacturers, presentations by the individual services, and studies on the state-of-the-art and other technical and tactical aspects made by the Weapons Systems Evaluation Group.

Army has been complaining that the aircraft developed and operated by the Air Force are too sophisticated and costly for use under rugged field conditions and are not equipped to deliver the types of weapons needed for close troop support.

Extensive evaluations were conducted by the Army Aviation Board at Ft. Rucker, Ala. of the single-jet, single-seat A4D, the single-jet, single-seat Fiat G.91 and the twin-jet, single-seat Northrop N-156, fighter version of the T-38 trainer.

Elaborate demonstrations of close support involving troops were conducted recently for the Army by the Air Force at Nellis AFB, Nev., and by the Marine Corps and Navy at Cherry Point Marine Corps Air Station, N. C.

In a move to accommodate Army wishes, USAF Chief of Staff Thomas D. White agreed with Army Chief of Staff George H. Decker to let the Army choose the interim close support weapon system. Army desires in aircraft for the mission emphasize:

• **Ability to operate** from sod or dirt air strips. This is directly related to aircraft weights and tire imprint area. The Unit Construction Index combines tire geometry, pressure and flotation with the aircraft weight. An index of over 60 requires concrete runways, and over 100, for such aircraft as the F-104, requires reinforced concrete. The de Havilland Caribou utility transport has an index of 9.61, for example, while the G.91 index is 9.8.

• **Relatively easy maintenance** under field conditions. Simplicity of bombing and navigation systems is the key to easy maintenance, requiring fewer and less skilled personnel.

• **Relatively low cost.** Supersonic aircraft carrying highly complex systems for delivering nuclear weapons cost too much for its mission, the Army says. What it needs is additional, cheaper aircraft to deliver conventional weapons.

Army believes planes could be kept in a general operational theater and would not require great ferry ranges.

The A4D would require larger tires but little other modification for the TAC role. The Marine Corps is already operating them from 3,000 ft. steel plank strips, using JATO for take-off and arresting wires for landing. It is already equipped with a tail hook for aircraft carrier work.

The tactical fighter program began as the Air Force TFX project. Soon after taking office, Secretary of Defense Robert S. McNamara ordered studies made to combine all the service requirements in this area into one package. He later referred to this in direct messages as the "Tri-Service Tactical Fighter." It would combine the missions of reconnaissance, interdiction, air superiority and ground support, and would have to operate from unimproved air strips and from aircraft carriers.

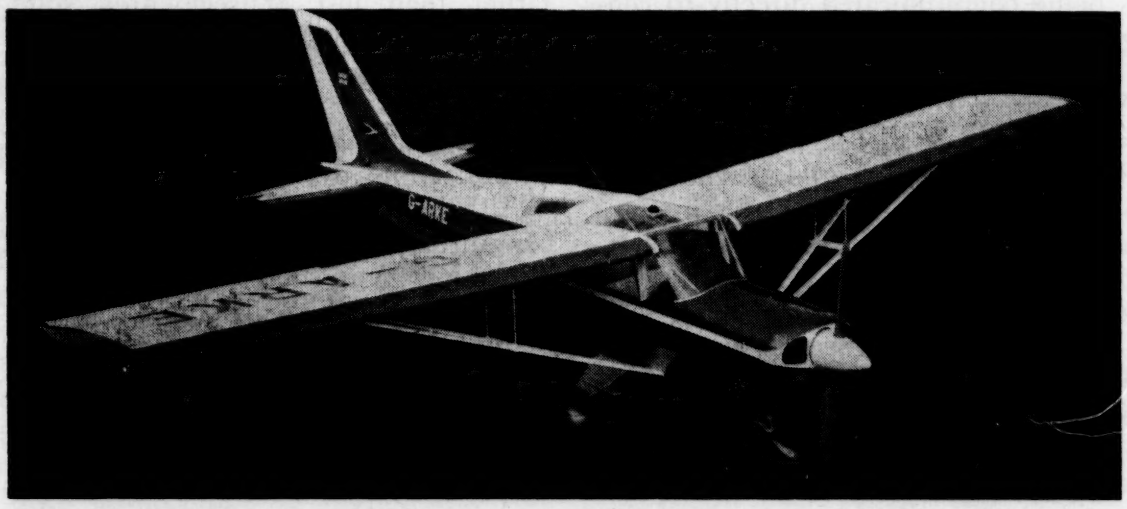
Both the Army and the Navy voiced strong objections to the Air Force approach under the TFX effort.

## Swedish Copter Order

**Geneva—Sweden had ordered the first six of 20 Vertol 107 helicopters optioned about a year ago along with 11 Agusta Bell 204Bs for delivery "this year." A Swedish air force spokesman said that it is not yet decided when the order for the remaining 14 Vertol 107s will be placed.**

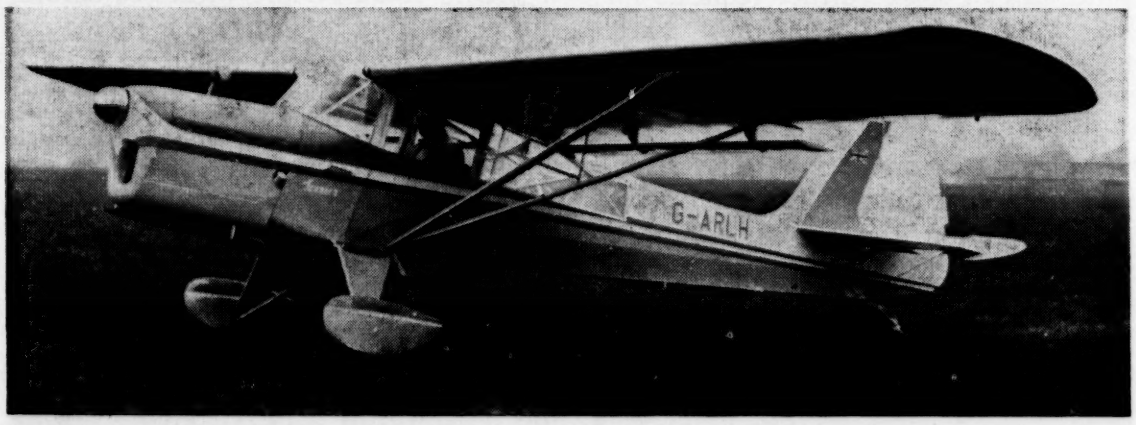
**Both types are powered by General Electric T58 engines made under license by de Havilland Engine Co., England, as Gnome engines. Airframes and powerplants are being purchased outright, and none will be license-produced in Sweden.**

**Two 107s are for the marine corps, and four are for the Swedish air force. Five 204Bs are for the Swedish army for troop and materiel transport, the remaining six are for transport and air/sea rescue service with the Swedish air force. Total estimated cost of the order is $20 million.**




## British Unveil Two Economy Lightplanes

**British Beagle-Auster A109 Airedale is a four-place lightplane which will begin coming off the production line this month. Price is $3,800. British Executive & General Aviation, Ltd.'s Beagle-Auster A61 Terrier (below) was developed from the Auster Mk. 6 military lightplane. It is designed for flying clubs and private use. Base price of the two/three-seat aircraft is $1,596.**



# Weather Hampers Manned Mercury Test

**Cape Canaveral**—Weather threatened last week to delay for the second time an attempt to send the first U. S. astronaut into space on a 16-min. suborbital flight down the Atlantic Missile Range.

First manned Mercury-Redstone (MR-3) flight was postponed on May 2 because of weather conditions both here and in the recovery area down range. A second attempt was planned tentatively for May 4. Navy Cdr. Alan B. Shepard, Jr., 37, was to make the first of at least three suborbital shots that will be flown before an attempt is made to put an astronaut in orbit, using the Atlas booster.

Subsequent MR flights will be made at six-week intervals by the MR-3 alternate pilot, Marine Lt. Col. John H. Glenn, and by the reserve pilot, Air Force Capt. Virgil I. Grissom. There are two Mercury-Redstone boosters available for any flights NASA might want to make in addition to these three.

First manned flight scheduled for the McDonnell Aircraft Corp. capsule was the 16th in the Mercury program and the fourth in the Redstone series.

Timing of the first orbital flight, which will follow the manned Redstone series, continues to be directly related to qualification of the Atlas launch vehicle with its capsule payload. First attempt to use an Atlas to launch an unmanned capsule into orbit was unsuccessful Apr. 25 (AW May 1, p. 30), although the capsule systems have performed well in both ground and flight tests.

### Poor Weather Conditions

First attempt to launch the manned capsule was scrubbed 140 min. before scheduled liftoff May 2 at 7:36 a.m. EST when weather at Cape Canaveral and in the recovery area was below minimums. NASA and the Air Force had established a maximum cloud cover of 0.4, with no clouds below 35,000 ft. Maximum wind velocity limit was 21 mph.

The launch site was completely covered by clouds, and there were rain squalls along with fairly heavy seas in the primary impact area, located at 27:10 n. latitude, 76:02 w. longitude.

Capsule systems operated normally during the initial MR-3 countdown, with the exception that the electrocardiogram telemetry signal was weak.

Anxiety bordering on desperation was felt by program managers because of the circus atmosphere and psychological pressures similar to those of the Vanguard era. More than 400 news correspondents were here for the launch, some of whom arrived several weeks ago. Effect of the long advance notice of the MR-3 mission was apparent on Mercury scientists, who recognized the need for success after the Soviet manned orbital flight (AW Apr. 17, p. 26).

### Mercury-Redstone Countdown

Manned Mercury-Redstone 11-hr. countdown begins two days before scheduled launch, with the count taking 5 hr. the first day and 6 hr. the second, plus built-in holds. Recycle minimum of 48 hr. is necessary if a postponement comes after the liquid oxygen is loaded.

Despite the success of Soviet Maj. Yuri Gagarin in his orbital flight, NASA maintains that manned ballistic flights of U. S. astronauts are necessary to:

- **Familiarize the pilot** with liftoff, boost, weightless, re-entry and landing phases of space flight.
- **Evaluate the pilot** in his ability to control capsule attitude before, during and after the retrorockets are fired, and to communicate and act as a scientific observer.
- **Measure the pilot's** reactions.
- **Continue qualifications** of the McDonnell Aircraft Corp. capsule for orbital missions.

### Redstone Pilot Tasks

Mercury officials have established specific control tasks and observations for Redstone pilots which appear to be more complex than those of Gagarin. During the entire 16-min. flight, the pilot reports every 30 secs. on his attitude control, fuel supply, gravity loading being experienced, pitch angle, cabin pressure, oxygen supply and unusual occurrences.

## Webb Urges Perspective

**Washington—Full public access to the Mercury program "frequently places a serious psychological burden" on the U. S. in its international position, according to James E. Webb, head of the National Aeronautics and Space Administration.**

**Commenting on the number of news representatives covering the launch of the manned Mercury-Redstone, Webb compared the opening shot with the Soviet manned orbital launch which "was already successfully in progress before announced and neither details nor the scientific data collected are yet available."**

**Webb urged the press and the public to keep the manned ballistic shot in its proper perspective, and he said "NASA has not attempted to encourage press coverage . . . it has responded to press and television requests."**

Major performance task comes 183 sec. after launch when the pilot can perform basic maneuvers, one axis at a time, in pitch, yaw and roll.

Throughout the flight, he reports on major sequences, such as completion of the boost phase, capsule-booster separation and jettisoning of the escape tower. He also reports on observations made through his viewing port and periscope. Immediate transmission of his report and biological measurements on telemetry are backed up by miniaturized tape recorders in the capsule which were developed by Consolidated Electrodynamics Corp.

Procedure in all manned Redstone flights is to have the pilot manually orient the capsule for retrofiring and to compensate for misalignment in retrorocket thrust by manual proportional control.

During the weightless phase of the flight, Mercury-Redstone pilots are to go through a touch test of the 127 panel instruments and controls with their eyes shut, a psychomotor sequence monitored by the cabin panel camera. Final major control task is spin control after re-entry.

Pilot countdown for Mercury-Redstone missions begins three days before scheduled launch when primary and back-up pilots begin to eat high protein, low residue foods. Second day before launch they go to the crew compartment of the Project Mercury hangars where they remain until launch.

Normal routine would be sleep without sedation from 8 p.m. the night before launch until 330 min. before launch.

### Pre-Flight Procedure

Sleep before the flight is not considered essential. After finishing showers and shaving, the pilots eat a meal consisting of orange juice, toast, milk and strawberries. Shepard added steak to his menu.

Pre-flight physical begins 280 min. before launch and includes electrocardiogram, blood pressure and temperature. At this time, the pilot is clad in thermal underwear. The heart action sensors for the examination and flight monitoring are attached by suction to tattoo marks on the chest. Respirometer is taped to the pilot's neck, and temperature is measured with a rectal probe thermometer. Miniature transistorized amplifiers for these instruments were built by Thompson Ramo Wooldridge, Inc.

The pilot then dons his pressure suit, and leaves Mercury Hangar S in

## Little Joe Escape Test

**Project Mercury capsule and its escape system survived an unusually severe test in its final checkout before the first manned suborbital flight.**

**The shot from National Aeronautics and Space Administration's Wallops Island, Va., site on Apr. 28 was to test the escape system under maximum dynamic pressure at an altitude of 40,000 ft. One of six rockets in the Little Joe booster misfired, causing booster and capsule to pitch over into a shallow trajectory.**

**Escape system activated while the booster was at only 12,000 ft. and carried the capsule to 14,000 ft. But the much denser air at the lower altitude produced a much higher pressure than escape during an orbital launching would, because the planned test speed of 1,100 mph. was reached in spite of the faulty trajectory. Undamaged capsule was recovered by helicopter 9 min. after it hit the water.**

a medical van for the launch pad. He carries a portable air conditioning unit for cooling while he is being driven to the pad.

During the trip, the suit is purged with 100% oxygen. Pilot is taken to the gantry and enters the capsule about 123 min. before launch.

Profiles for all manned Redstone flights are essentially identical, with a weightless period of 5.1 min., launch load of 6g, and re-entry load of 11g. Programed altitude is 117 mi., and range 295 mi. (AW Apr. 3, p. 33). Modified Redstone launch vehicle with vibration damper and coating material will be used for all missions.

Focal point of activities is the Mercury control center situated inland from the launch complex and consisting of five rooms—master operations, recovery operations, teletype center, recovery force communications and computer and technical facilities.

In the master operations room are representatives of NASA, the recovery force and the Air Force Missile Test Center. NASA representatives face a wall-to-wall world map which displays predicted orbital plots of Mercury-Atlas flights with a movable, computer-controlled replica of the capsule and red ball signifying the predicted impact point, a series of clock and numerical indicators of Greenwich Mean Time, orbit number, countdown time, hold or proceed, elapsed time and time to retrorocket firing.

The map shows the position of each tracking station as a white light, surrounded either by a green, orange, or red circle.

Recovery forces deployment and status, as well as pilot physiological condition, internal capsule performance, capsule pitch, roll and yaw positioning, and time remaining before ignition of retrorockets are displayed on various plotting boards and on consoles.

Inside the McDonnell capsule, the pilot faces an instrument panel mounting 127 lights, displays, controls, switches and fuses. Panel is divided into a main section and left and right consoles. Perkin-Elmer periscope (AW June 20, p. 321) is located in the center of the main section and provides the pilot with a 360 deg. view of the horizon.

Navigational instruments are located on the left and top center of the main section; right half carries environmental systems indicators and controls, electrical switches and communication systems controls. Side consoles include sequencing lights, warning panel and controls for the automatic pilot, environmental control, landing, abort and separation systems.

All systems within the capsule are powered by three 3,000 and one 1,500 watt-hour silver-zinc batteries, connected in parallel. Batteries, including an additional 1,500 watt-hour back-up unit, were developed by Eagle-Picher Co., and will function during a 16 hr. post landing period.

Capsule contains two D. B. Miliken Co. 16 mm. cameras to record instrument panel readings from launch through recovery, and to observe pilot reactions. The instrument camera has a 20,000 frame capacity, and the pilot monitor can take 10,000 frames. Pulse-operated cameras expose three frames per second during launch and re-entry, and one frame every ten seconds during other portions of the flight.

A three-component clock shows elapsed time and seconds-from-launch with manual reset, and has a timer to initiate retrorocket sequence.

The capsule basically is titanium, with titanium frame, stringers, internal and external skins, rings, adapter housing and rings. Internal skin is flat-rolled, external skin is corrugated. Both are 0.01 in. thick and are welded with a tungsten arc in an inert gas envelope. Material was fabricated by Titanium Metals Corp. of America.

# Titan I Test Vehicle Launched From Titan II Underground Silo

**Vandenberg AFB, Calif.**—Martin-USAF Titan ICBM was fired for the first time from an underground silo here last week.

After a brief interval during which flames poured from the exhaust vents, the missile emerged from underground and continued on what the Air Force and Martin Co. officials described as a highly successful flight, meeting all test objectives. A prime purpose of the test was to determine the effect of acoustical vibration and thermal shock on the missile while it was emerging from the 146-ft.-deep silo.

Three seconds after ignition, the hold-down provisions within the silo were released and the missile began its climb. Programed time for the Titan to clear the silo occurred five seconds later, or eight seconds after ignition.

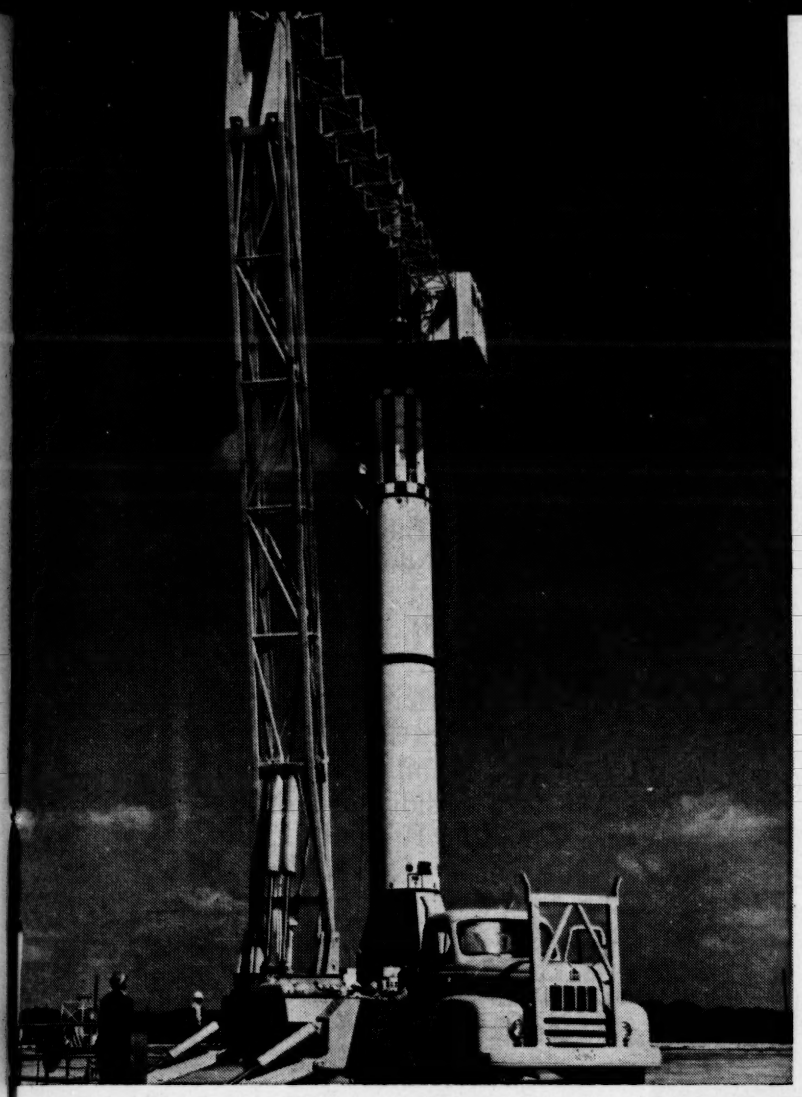
Objectives of the test included check of the range safety destruct system and to determine structural integrity of the missile airframe. Air Force officials said that arrangements had been concluded prior to the shot to allow the missile destruct system to be actuated any time 140 sec. after launch. The structural integrity portion of the test involved elimination of a programed reduction in the autopilot gain setting, thereby allowing the autopilot to have greater authority. This test occurred 96 sec. after launch at an altitude of 200,000 ft. It was calculated beforehand that failure to reduce autopilot authority while operating at the missile's speed and altitude possibly could overstress the airframe and result in destruction of the Titan. Severe course deviations were made, but the airframe appeared to resist the stresses imposed.

Destruction of the Titan took place as planned 140 sec. after launch.

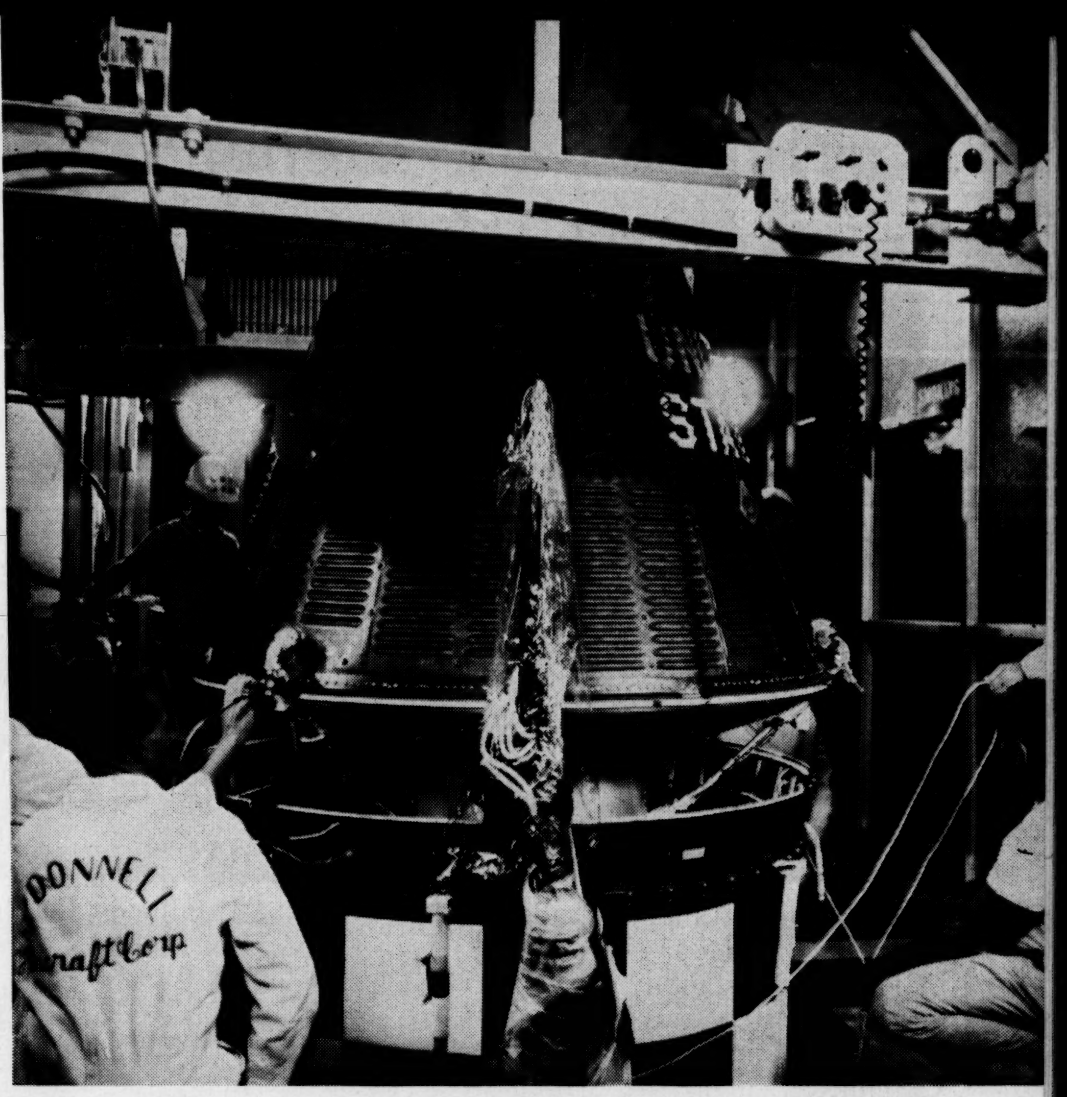
A W-shaped exhaust deflector was used to conduct the hot gases away from the silo opening. The missile rested at the apex of the center portion of the "W" with exhaust being conducted first downward, then reversing direction to emerge parallel to the direction of flight. Temperatures of about 5,000F were generated by the 300,000-lb.-thrust Aerojet LR-87-3 engine.

Although the silo used for the test is projected for Titan II, the missile used was a Titan I. Performance parameters of the Titan I engine are not the same as those for Titan II, but valid data resulted. Values applicable to Titan II will be extrapolated from the data taken.

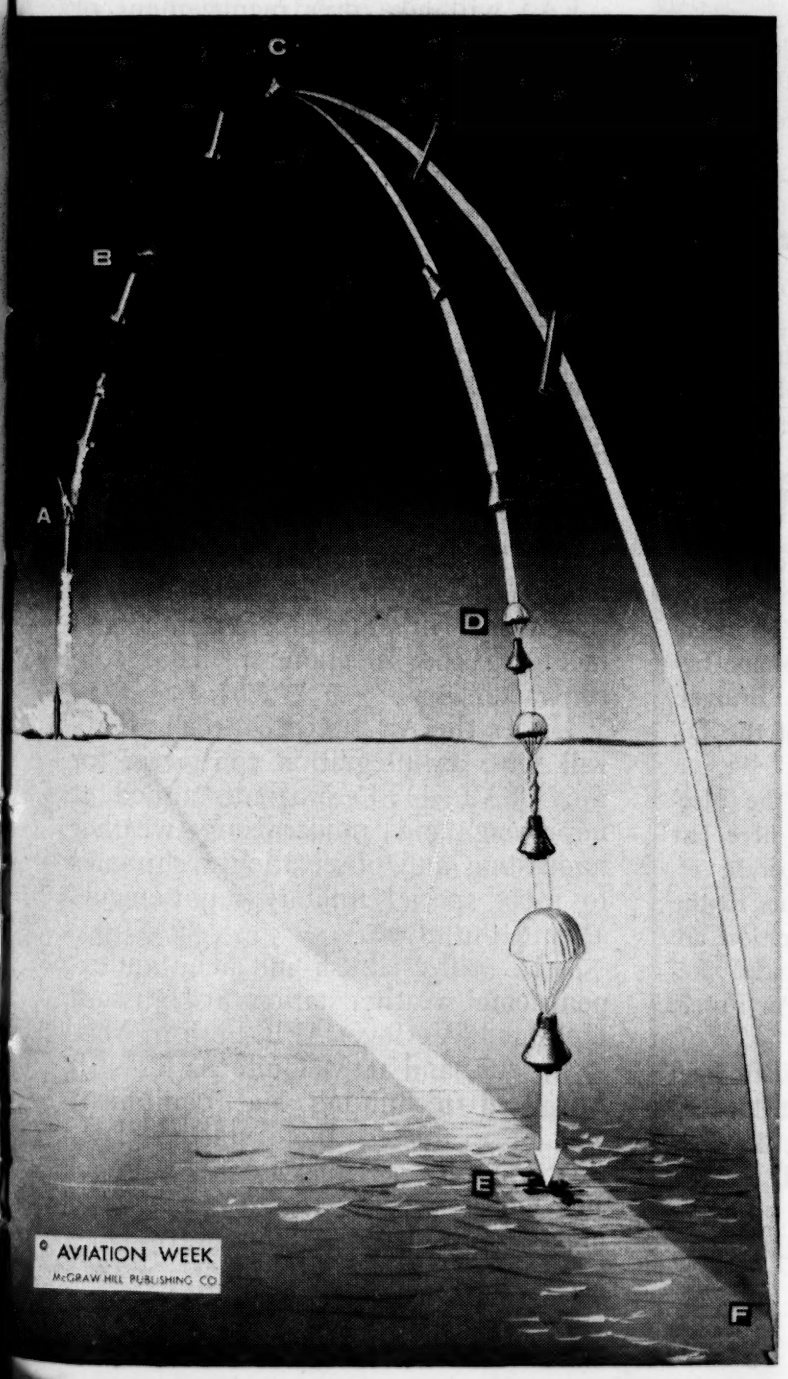
Since the objective of the test was to determine the emergence of the missile from a silo, a dummy second stage was installed with its fuel tanks filled with water ballast to simulate weight and mass distribution of the actual second stage.



Specially designed "cherry picker" crane is used to remove astronaut from capsule in case launch is canceled late in the countdown. Below, planned trajectory would carry astronaut 115 mi. high, more than 200 mi. down Atlantic Missile Range on 16-min. flight.




McDonnell Mercury capsule No. 7 is mated to Redstone booster in newly built clean room on third level of Redstone gantry at Complex 5 in preparation for first sub-orbital launching of a U. S. astronaut.




# Launch, Recovery Gear Prepared For Manned Mercury-Redstone

Amphibious Army recovery vehicle (below) is used to retrieve Mercury capsule if it must escape from launching vehicle while booster is on the launch pad. Hydraulic crane lifts capsule, LARC (lighter, amphibious resupply cargo) returns it to forward medical center in old Bomarc area at Cape Canaveral.

# Air Force, Navy Report Progress In Contract Overcharge Recovery

**Washington**—Air Force and Navy have reported substantial progress to the House Armed Services Investigating Subcommittee in recovering contract overcharges alleged by General Accounting Office.

Recoveries by the two services have totaled over $19.2 million since June, 1959, when GAO allegations of overpricing, particularly on incentive-type contracts, were first made at congressional hearings.

The manner of recovery was not specified—whether USAF or Navy used coercion on a contractor, such as Justice Department action—or whether a contractor made a voluntary refund once the overpricing was called to his attention.

The GAO testimony of two years ago was used by Rep. Carl Vinson (D.-Ga.), chairman of the parent Armed Services Committee, in his successful fight for extension of the renegotiation law without amendment.

### Preventive Measures

In addition to reporting on past overcharges, USAF and Navy spelled out to the subcommittee, headed by Rep. Edward Hebert (D.-La.), steps that have been taken to preclude inaccurate pricing in the future. These include:

• **Extensive specialized training** of procurement personnel. Service negotiators are required to pass rigid examinations at the completion of courses. The salaries of civilians have been increased.

• **Inclusion of a requirement** for accurate pricing in contracts. Comptroller General Joseph Campbell agreed with subcommittee members that a statute requiring accurate pricing "might be even more impressive upon contractors."

• **"Increased audit reviews"** of contract proposals. USAF testified that costs proposed by industry were negotiated downward by $520 million during the January-October, 1960, period as a result of audits. The office of Air Force's Auditor General reviewed $11.7 billion in prime contract cost proposals by industry and $6.1 billion in subcontract cost proposals during Fiscal 1960, Joseph S. Imirie, assistant secretary of the Air Force for materiel, pointed out. This compared with $750 million in prime contract proposals and $2.2 billion in subcontract proposals during Fiscal 1956, he said.

The services defended the controversial fixed-price incentive type contract widely used in aircraft and missile procurement, maintaining that tight control of overpricing now assures the establishment of realistic "target" prices. No objection to this position was raised by subcommittee members.

At the June, 1959, hearings, GAO alleged excessive pricing of $29.2 million on contracts it had investigated and reported that this would result in increased costs to the government of over $15.6 million: $6.3 million on Air Force and $9.3 million on Navy contracts. Results of actions taken by the services include the following:

• **Air Force recovered** a total of $7 million—more than the $6.3 million identified by GAO as overcharge. The major recoveries were: McDonnell Aircraft Corp., $1.5 million; Boeing Airplane Co., $1.1 million; Lockheed Aircraft Corp., $1.4 million; Avco Corp., $1.1 million.

• **Navy recovered $4.6 million,** and anticipates the recovery of an additional $4.5 million through action by the Justice Department. This would make a total recovery of $9.1 million, compared with the $9.3 million recommended by GAO. The major Navy recoveries: McDonnell, $2.7 million, and General Motors Corp., $1.2 million.

The two cases Navy has referred to Justice Department—one involving $4.4 million and the other $88,100—are not identified, in line with Justice Department policy on cases under investigation.

Since the mid-1959 hearings, GAO has alleged overpricing on USAF and Navy contracts totaling $33.7 million and reported that this has resulted in overcharges of $23.3 million.

Air Force has recovered a total $7.6 million out of $13.7 million identified by GAO as overcharges on its contracts. The major recoveries were: General Electric Co., $3.7 million; Continental Aviation and Engineering Corp., $884,000; Thompson Ramo Wooldridge, $615,000, and Northern Radio Co., $506,000.

The largest amounts identified by GAO as overcharges which have not yet been recovered are: Convair Division of General Dynamics Corp., $3.4 million; Allison Division of General Motors, $1.5 million; Fairchild Engine and Airplane Corp., $1.3 million.

## Space Tube Program

**San Francisco—National program to encourage and coordinate applied research in superpower tubes which may be needed for deep space probe tracking and communications, detection and tracking of ICBM warheads, and for radiation weapons, has been set up within the Department of Defense.**

**The informal program, directed by an inter-agency steering committee, is seeking tubes capable of generating megawatts of average power at microwave frequencies, according to James Bridges, director of electronics, Office of the Director of Defense.**

**Bridges, who spoke before the electronics components conference here last week, indicated that four separate efforts involving distinct approaches to the problem of high-powered generation are being sponsored by the Advanced Research Projects Agency, Army, Air Force, and his office.**

**A recent contractors' symposium held at Lincoln Laboratories indicated excellent progress toward achieving the necessary high powers at X-band, Bridges said.**

## Weather System Effort Management Is Split

Program to develop a semi-automatic system (433-L) for collecting, analyzing and disseminating weather data, jointly sponsored by the Air Force, Federal Aviation Agency and the Weather Bureau, has split into two complementary efforts.

FAA will take over management of that portion of the original program intended to provide service for civil and military aircraft operating in the U. S., while the Air Force will retain responsibility for the portion required for military operations outside the U. S. (AW Dec. 26, p. 13.) The FAA area represents about 75% of the original program effort

United Aircraft Corp., original USAF prime contractor for the 433-L weather system (AW July 20, 1959, p .70), now has been awarded separate contracts by Air Force and FAA. Under the FAA contract, UAC's Weather System Center will perform system engineering, but FAA's Bureau of Research and Development will retain program direction, including the selection of major subcontractors.

Under the Air Force contract, UAC will serve as integration contractor for the USAF 433-L program, aimed at improving and modernizing weather forecasting and observation techniques to meet special military requirements around the globe.

UAC will establish and maintain experimental weather stations at Hanscom Field and Westover AFB, both in Massachusetts, and at McGuire AFB, N. J. Advanced techniques and equipment will be evaluated there starting later this spring for eventual use in a national and global weather system for use by high-altitude, high-speed aircraft.

# Explorer XI Relays Cosmic Ray Study Data

**Cape Canaveral**—Explorer XI gamma ray astronomy satellite was launched into an initial orbit with 1,111-mi. apogee and a 301-mi. perigee, and is returning telemetry data designed to be used in determining the origin of cosmic rays.

The 82-lb. Explorer XI was launched into its elliptical orbit Apr. 27 using a Juno II vehicle in an effort to make the first measurements of gamma rays unhampered by the effects of the earth's atmosphere (AW May 1, p. 37). Complete orbital package weighs 94.8 lb., including the spent 44-in. fourth stage rocket case which remains attached and acts as an extension for the telemetry antenna.

The satellite is in a controlled 10-rpm. tumble so it can scan its environment.

Scientists here said they hope to obtain usable data for a year to study these opposing theories on the origin of cosmic rays:

- **Surface emission,** in which cosmic rays are produced at the surface of stars and the sun.
- **Supernovae aftermath,** which holds that cosmic rays are caused by the cloud of hot gas emitted by an exploding star. The Crab Nebula is being studied by the satellite.

Also to be studied are theories on the history of the universe, both expanding and steady state concepts. Basis of the theory of expansion is that the universe was created by a primeval explosion.

Steady state theory is based on continuous creation of matter, which would be traced to radiant energy in the form of cosmic rays.

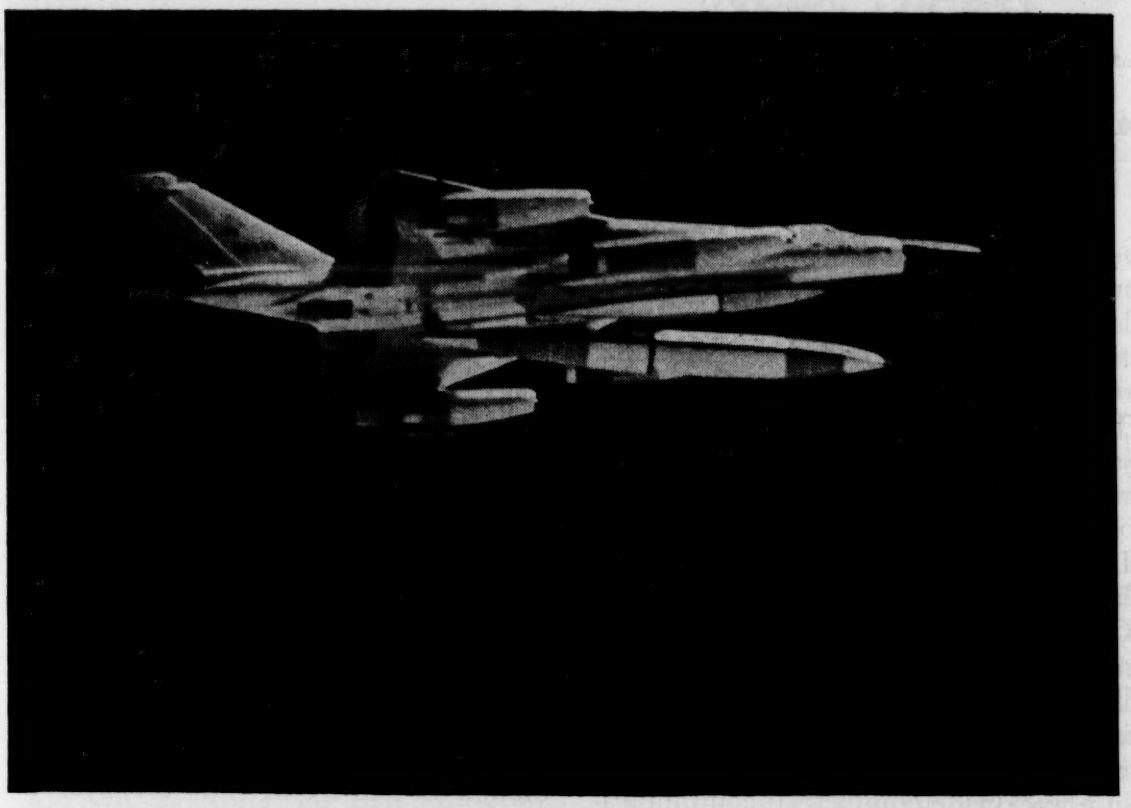
The experiment package (AW Apr. 3, p. 29) is powered by 12 nickel cadmium batteries charged by banks of solar cells. The telescope basically is a sandwich to crystals which emit an electron and positron when struck by a gamma ray. The impingements then are relayed to the earth by a four-leaf data transmitter operating on a frequency of 107.97 mc. Tracking transmitter operates at 108.06 mc.

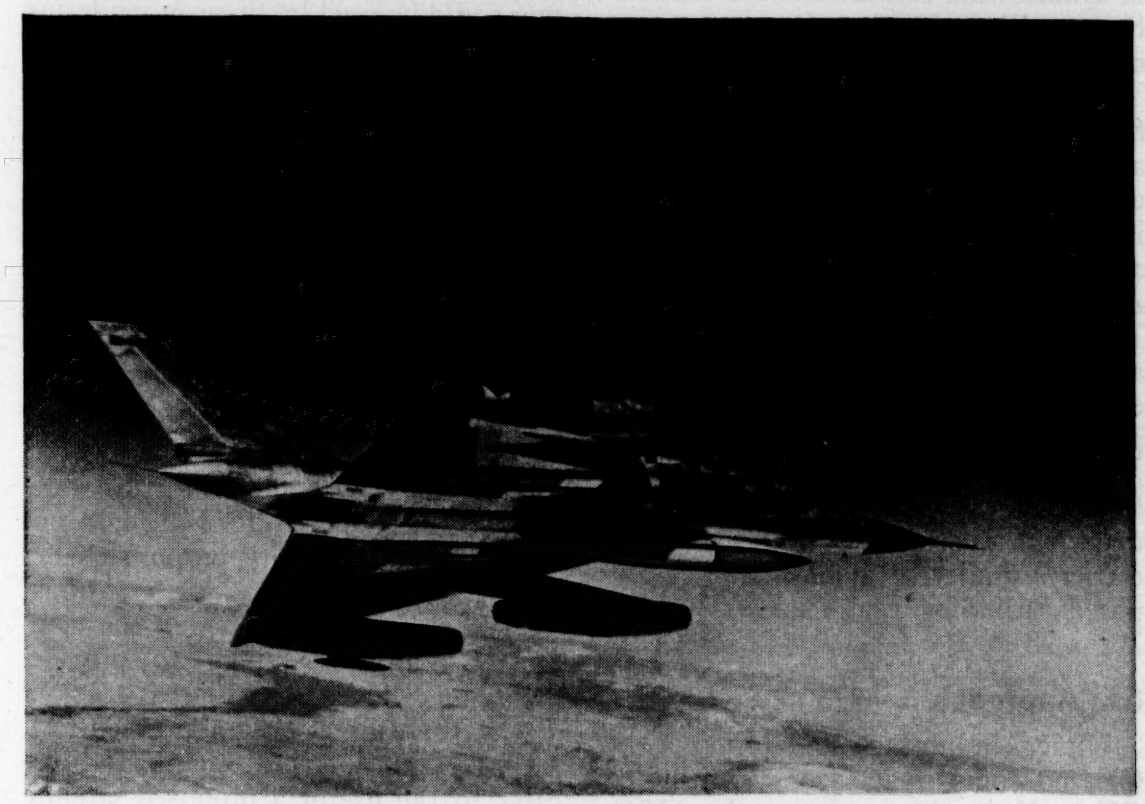
Explorer XI is being tracked by stations of the Minitrack network, and data are being reduced by the National Aeronautics and Space Administration's Goddard Space Flight Center.

Planned orbit was 700-300 mi., with a 98-min. period. The initial period was 108.05 min.

Experiment was prepared by Dr. William Kraushaar and Dr. George Clark of Massachusetts Institute of Technology.

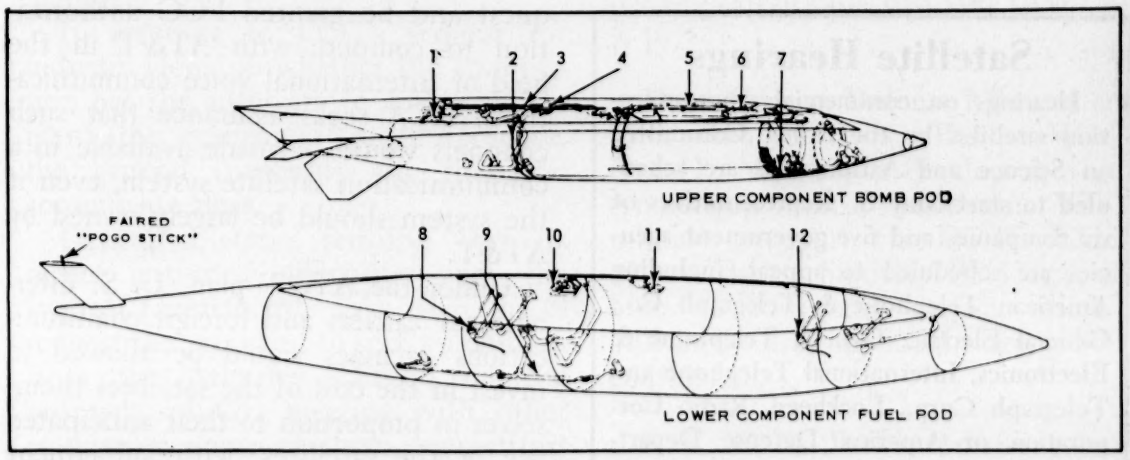
Project scientist is Dr. James Kupperian of Goddard, and Dr. Nancy Roman is headquarters program chief.





## B-58 Hustler Sheds Fuel Pod

**Fuel container is jettisoned from B-58 in supersonic flight in first photo of pod drop (top). Streamlined spar at aft end remains attached to aircraft until fuel pod assumes nose-down attitude. Second photo shows B-58 with only small armament pod remaining (AW Sept. 5, p. 30). Pod drop tests are being conducted by Convair and Air Force crews which are located at Kirtland AFB, N. M.**




**Numbered members of B-58 two component pod are: 1—Gas generator for hook release actuator. 2—Shaped charge ring. 3—Explosive disconnect. 4—Cartridge-actuated cutter. 5—Forward hook actuation rod. 6—Electrical disconnect. 7—Filler. 8—Aft releaser. 9—Fuel line. 10—Electrical disconnect. 11—Gas generator. 12—Forward releaser.**

# Joint Satellite System Gaining Support

By Philip J. Klass

**Washington**—Industry views on commercial communication satellites, filed last week with the Federal Communications Commission, indicate a softening of opposition to American Telephone & Telegraph Company's latest plan for a jointly owned space system, providing regulation and safeguards are adequate.

A potential competitor to AT&T and Lockheed entered the picture last week, however, with the announcement by General Electric that it has formed a new subsidiary, Communication Satellites, Inc. Purpose of the new company is to "act as a focal point for cooperative participation by private enterprise in a worldwide commercial communication satellite system under government regulation."

The new company promptly filed a formal application with the FCC for authorization to establish a commercial communication satellite system, making it the first to formally request such authority.

Earlier, AT&T and International Telephone and Telegraph Co. requested and received FCC authorization for experimental communication satellite programs.

Communication Satellites, Inc. is intended to serve as a nucleus for the formation of a "common carrier's common carrier," similar to that which was proposed earlier by Lockheed (AW Mar. 20, p. 28).

### GE Approach

Under the arrangement proposed by GE, no company or agency, including GE itself, would own more than 10% of the stock in the company, although for the moment Communication Satellites is wholly owned by GE. This is intended to attract and reassure smaller international communications companies which are apprehensive about protection of their interests in a space communication system dominated by AT&T.

Lockheed also has indicated willingness to accept minority ownership in its proposed combine, or even to bow out entirely.

Recognizing this objection, AT&T in its Mar. 21 letter to the FCC, and in its reply to the current inquiry (AW Apr. 10, p. 34), has offered to share in ownership of the system it proposes. Further, it has stated a policy of system utilization intended to reassure smaller users:

"Participation would be limited, at the U. S. end, to international common carriers fully subject to regulatory jurisdiction of the FCC. The satellite system could be used by them in rendering any overseas communications services which they now are or in the future may become authorized by the commission to provide . . . access to the satellite system would thus be assured on nondiscriminatory terms approved and supervised by the commission," AT&T said.

### RCA Interpretation

Radio Corporation of America and its subsidiary RCA Communications, Inc., said in their reply to the FCC inquiry that they understand this statement to mean that AT&T "would not restrict the use of its proposed satellite system by other international carriers for any service which the commission authorizes them to provide, including voice transmission.

"If this understanding is correct, AT&T's position on principles applicable to the use of a proposed satellite system appears to be similar to our position," RCA said.

This reference to voice communications is a crucial test of AT&T intent, since it now has practically a monopoly on international voice communications. If RCA, or another carrier, should request and be granted FCC authorization to compete with AT&T in the field of international voice communications, RCA seeks assurance that such channels would be made available in a communication satellite system, even if the system should be largely owned by AT&T.

Under the AT&T plan, U. S. international carriers and foreign communications agencies would be allowed to invest in the cost of the satellites themselves in proportion to their anticipated use of the satellites, with subsequent adjustments to correct for any differences between actual and anticipated use.

Or a user could lease facilities of the satellite system without capital investment.

On this basis, AT&T would be the largest and dominant participant in system ownership.

Ground stations in the U. S. used with the satellites could be jointly owned by the U. S. international carriers on a similar investment sharing basis, or carriers could establish their own stations.

Still another possibility for smaller carriers would be to lease the services of jointly owned terminal facilities, according to AT&T.

### Ground Station Management

RCA says it would want to own, operate and maintain its own ground transmitting and receiving stations for use with communication satellites, and that this should be a fundamental principle for any space communication system that FCC authorizes.

RCA, which together with General Telephone & Electronics has held discussions with Lockheed on the technical and management problems of a space communication system, told the FCC that it has "not as yet determined our interest in the common carriers' carrier approach." However, it adds that studies indicate such a joint venture would not be economically feasible

## Satellite Hearings

**Hearings on commercial communication satellites by the House Committee on Science and Astronautics are scheduled to start May 8. Representatives of six companies and five government agencies are scheduled to appear, including American Telephone & Telegraph Co., General Electric, General Telephone & Electronics, International Telephone and Telegraph Corp., Lockheed, Radio Corporation of America, Defense Department, Federal Communications Commission, National Aeronautics and Space Administration, State Department and Office of Civil and Defense Mobilization.**

## Space System Timetable

**Three companies expressing a desire to implement a commercial communication satellite system disclosed the following tentative timetables:**

- **American Telephone & Telegraph Co.: Full-scale commercial system, employing low-altitude polar orbits, could be in operation within 3-4 yr. Company says it can deliver the first of several experimental satellites by December, providing permission is promptly obtained to use launching facilities (AW Apr. 17, p. 104).**
- **General Electric: First five satellites of a 10-satellite, 6,000 mi. high equatorial (non-synchronous) system could be operational by mid-1964, with the complete system operational by mid-1965.**
- **Lockheed: System, consisting of a pair of synchronous (22,300 mi.) satellites in equatorial orbit over the Atlantic plus another pair over the Pacific, could be achieved with a 3-5 yr. go-ahead, although the system would not be able to justify its cost until the late 1960s or early 1970s. If a decision were made to proceed full speed because of national prestige, "U. S. government subsidy might be required during those early years," Lockheed says.**

## Mach 3-Plus Interceptor

**New York—Manned interceptor aircraft capable of Mach 3 and faster were predicted for the 1970-80 era by Neil E. Firestone, general manager of General Electric's Flight Propulsion Division, at the 23rd annual meeting here of the Aviation/Space Writers Assn.**

**Manned bombers that will fly at speeds exceeding the 2,000-mph. capability of the North American B-70, and supersonic logistics aircraft, also were predicted for the same period by Firestone.**

by private enterprise without AT&T's voice traffic.

RCA does not strongly object to an AT&T-dominated communication satellite system, providing minority users are assured of direct access to and nondiscriminatory use of the satellites on reasonable terms and without restrictions imposed by the owner. But it cautions that ownership or control by a single company could mean that the technology of satellite communications might consist principally of the technology of a single company.

Elsewhere in RCA's comments to the FCC, the company indicates that it favors the use of communication satellites in a synchronous equatorial orbit at 22,300 mi. altitude. It adds that the system should be designed to provide maximum service with the minimum number of satellites to keep space as free as possible of useless orbiting debris. AT&T favors the use of many low-altitude satellites in random polar orbits, at least initially.

International Telephone & Telegraph Company and its international communications subsidiary, American Cable and Radio, expressed strong support of a space communication system which would be owned and operated by international telecommunication companies.

"It is our view that ownership, maintenance and operation of satellite communication systems should be exclusively in the hands of companies having an undiluted interest and responsibility in the rendering of international telecommunication services," the ITT affiliate told FCC. "There is little logic to having one element of the system (ground facilities) controlled by common carriers and the other by non-communication entities."

The current ITT statement, coupled with earlier expressions, indicates that the company supports the plan proposed by AT&T.

General Telephone & Electronics told the FCC it opposes both the concept of a communication satellite system owned by a single large carrier, such as AT&T, and the plan of companies outside the telecommunications field to participate directly in ownership of the space system. "There appears to be no necessity for including ownership participation by other than common carrier companies if that group alone can raise adequate capital, as appears to be the case," GT&E told the commission.

As the smaller of the two major U. S. domestic communications companies, GT&E called for assurance against discrimination in the use of the system by competing companies. "Operating rules and regulations and such mechanical devices as are employed should insure that all message traffic of the same class will be handled on a 'first-come first-served' basis," GT&E said.

AT&T said in its comments to the commission that the FCC has the authority to impose on its licensees a requirement of non-discriminatory access to the system. The company took a swipe at combines that include aerospace companies, such as Lockheed and GE, pointing out that "questions . . . concerning the extent of the commission's jurisdiction over participants who were not themselves international carriers . . . are not presented by the plan we propose."

The opposition of the communications companies to having "outsiders" edging into their field as part owners of a space communication system reflects a "lack of understanding of the design, operation and service problems involved in any space system," according to an official of one interested aerospace company. It demonstrates why a partnership between communications and aerospace companies is needed, he says.

The fact that GE is willing to limit its ownership to no more than 10%, and that Lockheed has told FCC that it desires to invest in ownership only to the extent needed to advance the project, reflects the basic interest of the two firms—building, launching and servicing the satellites themselves.

Lockheed told the FCC that if its proposed Telsat combine reaches fruition, it intends to compete both for the manufacture of the satellite vehicles and for the role of space system manager.

In response to FCC's request for industry views on whether the commission has the authority to authorize the plans the companies might propose, the general consensus was that the commission does.

General Electric, sensitive over its recent anti-trust difficulties with the Justice Department, asks that FCC request the president to seek an opinion from the Attorney General on the propriety of GE meeting with other companies, some of them competitors in other fields, to discuss details of the space communications system combine it has proposed.

# News Digest

**Air Force** reports that moisture seeping into an electrical circuit in an F-100 fighter was responsible for release of a Sidewinder missile which shot down a B-52 bomber as the fighter made a practice firing run (AW Apr. 17, p. 30).

**Boeing Airplane Co.** last week dropped the word "Airplane" from its name. Name now is The Boeing Company. Stockholders at the annual meeting also were told Boeing first quarter earnings were $5,956,820 on sales of $325,201,841.

**American Bosch Arma Corp.,** which manufactures inertial guidance systems for the Atlas ICBM, is seeking to acquire a semiconductor component company so that it can internally satisfy the bulk of its large requirements for these avionic components. Arma is known to be interested in Rheem Semiconductor Corp. although the latter's management insists the company is not for sale.

**Marshall Industries,** San Marino, Calif., has acquired Aerolab Development Co., Pasadena, from Ryan Aeronautical Co. Aerolab will continue as a Marshall subsidiary, supplying sounding rocket and space probe vehicles. Ryan Aeronautical Co. and its subsidiary, Ryan Communications, Inc., are negotiating for acquisition, by key personnel in the subsidiary, of Ryan's 80% stock ownership in the subsidiary.

**Edward L. Katzenbach, Jr.,** has been appointed deputy assistant secretary of defense (manpower) with responsibility for education and manpower. He formerly was associated with the Air Force Electronics Directorate.

**Carl F. W. Borgward,** GmbH. has decided to discontinue development of its three-seat Kolibri I, Germany's first post-war helicopter, following financial difficulties, which resulted in the firm's reorganization early this year (AW Apr. 3, p. 32).

**West German Defense Ministry** confirms reports that Dornier-Werke, GmbH., Munich, is developing a government-sponsored twin-engine VTOL military transport, the Do-31. Choice of two Bristol Siddeley BS-53 gas turbines to power the project, which is only in the drawing-board stage, is being considered.

**F. E. N. St. Barbe,** remaining founder of de Havilland Aircraft Co., Ltd., has retired from the company's board of directors.

# U.S. Plans to Rewrite Export-Import Pacts

**Increased foreign aviation sales effort expected; quality control to be stressed in new agreements.**

By David H. Hoffman

**Washington**—Department of State, anticipating more vigorous international attempts to penetrate the U. S. aviation market, plans to renegotiate a majority—and perhaps all—of the agreements under which the U. S. recognizes foreign certification of aircraft and engines.

Acting on the advice of the Federal Aviation Agency, the State Department is expected to stress quality control measures in the forthcoming negotiations. It does not plan to insist on new restrictions designed only to shield the U. S. aircraft industry from foreign competition.

The major reason for rewriting the so-called export-import bilaterals, some of which date back to the late 1920s, is to define precisely which components of an aircraft or engine are covered by each agreement. But should State Department and FAA shorten such lists of mutually recognized components, the over-all effect will be to discourage foreign exports to the U. S., regardless of U. S. intentions.

FAA officials in the Bureau of Flight Standards do not yet agree on the exact form their recommendations should take. But after examining the bilateral question for more than a year, some agency spokesmen are predicting that formal recommendations will be forwarded to State Department "within the next few months."

Reciprocal Agreements on the Mutual Recognition of Airworthiness Certificates are now in effect between the U. S. and 14 nations: Australia, Austria, Belgium, Canada, Denmark, France, Italy, The Netherlands, Norway, Spain Sweden, Union of South Africa, United Kingdom and West Germany.

A fifteenth agreement is being negotiated with Switzerland, where U. S. avionics manufacturer William P. Lear, Sr., has formed the Swiss American Aviation Corp. to build the SAAC 23—a twin-jet, eight passenger executive aircraft (AW Mar. 6, p. 87). Other nations with expanding aircraft manufacturing industries—Japan, Mexico and Israel, for example—are expected to make similar overtures this year.

U. S. industries imported $86.8 million worth of foreign aircraft, engines and spare parts in 1956, when the total value of such imports reached a postwar high. Their total value was $28.8 million in 1954, $32.1 million in 1955, $52.8 million in 1957, $78.8 million in 1958, $68.1 million in 1959 and $62.3 million in 1960.

As U. S. manufacturers of airframes and aircraft accessories shift their emphasis toward projects associated with space exploration, many observers believe that foreign industries will take a fresh look at the U. S. market for light transport and executive aircraft. There are also indications that foreign manufacturers will seek licensing rights to build replacement parts for the big fleet of aging piston transports still operated by U. S. corporations and airlines.

The U. S. bilateral with the United Kingdom, which took effect in October, 1934, covers only "aircraft" and has never been amended. Through a process of mutual interpretation, however, the agreement has been broadened to include engines, propellers and major components.

The bilateral with Australia, which took effect in November, 1959, is somewhat more precise, but still fails to include any mention of components. It states: "As used herein, the term aircraft shall include civil aircraft . . . aircraft engines and propellers which have been exported in accordance with this agreement."

Precise procedures for applying the bilateral agreements generally are "left to the direct negotiation" of the appropriate aviation authorities. However, the United Kingdom bilateral and several others go beyond this by stipulating that the two nations shall "exchange details of the performance of the aircraft in its official flight test, and particulars of the normal engine speed in flight (with the airscrew fitted to the particular aircraft) and of the normal engine consumption of petrol and oil . . . and rigging particulars where applicable."

The two nations also agreed in 1934 to afford one another "the fullest opportunity" to examine mutual "standards as to materials, structural conditions, inspection methods, etc., laid down and enforced."

This latter provision underscores the traditional U. S. approach to such agreements—that they be strictly bilateral. FAA realizes that no amount of field inspection can be substituted for substandard manufacturing techniques and the absence of quality control in the factory. In rejecting the European view that a common airworthiness code can form the basis for multilateral negotiation of export-import agreements, FAA maintains that:

- **Some nations with industrial** capability nevertheless lack governmental agencies with sufficient know-how and experience to ensure all their aircraft products meet U. S. standards of reliability. For this reason, it may be desirable to apply the principle of mutual recognition selectively to include, say, aircraft, engines and components in one bilateral and only specified components in another.
- **Annex Eight** to the International Civil Aviation Organization (ICAO) convention, the most widely accepted international document on airworthiness, is far too vague to serve as a standard. To amend Annex Eight a consensus of the ICAO membership is required.

To establish whether a nation seeking a bilateral with the U. S. will export high-quality products only, FAA informally rates its counterpart agency within the foreign government. If that agency meets FAA criteria, a bilateral recommendation is sent to the State Department.

## Northwest DC-8s

**Northwest Airlines is negotiating sale of its five Douglas DC-8 jet transports, with either SAS or KLM Royal Dutch Airlines as probable buyers. SAS needs aircraft to supplement its jet fleet because of delays in delivery of the Convair 990.**

**If the deal develops, Northwest is interested in buying Boeing 707-320B turbofan transports for nonstop service on its Seattle-Tokyo route. DC-8 flights now stop at Anchorage, Alaska. Northwest also may be interested in obtaining more 720Bs.**

**Six 720Bs are on order by Northwest, and six more are on option. Four 720Bs that will be leased by Trans World Airlines are in Northwest configuration, but were not airplanes built specifically by Boeing for Northwest. TWA has a 13-month lease on the 720Bs, after which they could conceivably go to Northwest if TWA does not renew the lease.**

## TWA Orders 30 Turbofan Transports

New York—Trans World Airlines' leasing of four Boeing 720Bs as part of a 30 plane jet order indicates that TWA will not get the last four Convair 880s on a Hughes Tool Co. order for 30 aircraft. TWA acquired 20 of the 880s on the original order and Hughes released six of the aircraft to Northeast.

Revealing the $187 million order placed with Boeing, TWA President Charles C. Tillinghast, Jr., said that the purchased aircraft will consist of 20 707-131Bs and six 707-331Bs (AW May 1, p. 63).

All the aircraft will be powered by 18,000-lb. thrust Pratt & Whitney JT3D-3 turbofan engines. The carrier will purchase an additional 38 engines as spares. TWA currently either operates or has on order 47 four-engine jet aircraft.

TWA will invest $40 million of its own funds for the new 707s. It will borrow the rest from financial institutions. This latest purchase will bring the carrier's over-all involvement in jet equipment up to almost $500 million.

In addition to Equitable Life Assurance Society and Metropolitan Insurance Co., both participants in TWA's recent financing, Prudential Insurance Co. may take part. TWA's banking group, led by Bank of America, also is expected to participate.

The 26 aircraft TWA is purchasing will be delivered by the fall of 1962; the four leased 720Bs will be delivered to the airline in September.

Earlier, at a board meeting in Kansas City, Ernest R. Breech was elected chairman of the board of Trans World Airlines. He succeeds Warren Lee Pierson who announced his retirement after 14 years as chairman and 16 years as a member of the board. Pierson continues, however, as chairman of the executive committee and a TWA board member.

## Blanket Exemption Is Offered for Charters

**Washington**—Changes in Civil Aeronautics Board's economic regulations permitting supplemental and all-cargo carriers to apply for 180-day blanket exemptions for transatlantic charters went into effect late last month.

The Board also has issued a show cause order on proposed changes in Part 212 of the Economic Regulations to allow foreign air carriers to conduct off-route charters under similar blanket exemptions.

CAB is attempting to cut paper work with the U. S. carriers and give them more flexibility.

Before Part 295 of the economic regulations was changed, a supplemental or all-cargo carrier had to get prior Board approval for each charter flight. Under the new provisions, these carriers—if their applications for blanket exemption are approved—may fly as many transatlantic charters as they wish without prior Board approval during their 180-day blanket exemption period. The 180-day blanket exemption is seasonal and does not extend beyond Sept. 30 of any year.

The carriers must file, within 15 days after the end of every month, information regarding each charter, indicating the date of trip, points served, number of round-trip and one-way passengers, name of chartering organization and basis for concluding that it is a bona fide charter group, and basis for the tariff charge.

If adopted, the proposed foreign air carrier exemption would permit off-route charter operations in the U. S. or the home nation or any of its possessions as long as the trip was via one of the carrier's specified terminal points. A carrier would not be permitted to exceed 10% of its total scheduled annual revenue plane miles with this charter business. As with U. S. supplemental carriers, specific information regarding the charters would have to be filed within 15 days after the close of each month.

## Airline Unions Sued By Southern, Western

**Washington**—Damage suits totaling $8 million have been filed against striking employes by Southern Airways and Western Air Lines.

Southern is seeking $3.5 million in general damages and $3.5 million in punitive damages from the Air Line Pilots Assn. on grounds that the union has issued a series of false and defamatory statements against the company during the course of the strike which began last June 5.

A petition filed by the airline in the Fulton County Superior Court in Atlanta, Ga., contends that ALPA made the statements in handbills, bulletins and letters to employes and stockholders of the airline. Requesting a permanent injunction to prevent the pilots from further distribution of such material, the airline claimed ALPA's actions constituted an attempt to destroy the goodwill and integrity of the company.

Western filed its suit against the Flight Engineers International Assn. and 123 engineers who participated in a nation-wide walkout in February.

## National Grounded By Machinist Strike

**Washington**—Labor Secretary Arthur Goldberg moved quickly last week to settle a strike of National Airlines ground personnel that led to a complete shutdown of the carrier's service.

National ceased operations and furloughed 4,000 employes May 2 after a strike by 1,100 ground employes, called by the International Assn. of Machinists because of a contract renewal dispute.

IAM members were scheduled to vote late last week on accepting government arbitration, which was proposed by Goldberg and accepted by the airline.

The arbitration would be conducted by Nathan Feinsinger, who earlier was named to head a group investigating flight engineer complaints which led to a major U. S. airline strike in February.

Goldberg suggested a meeting between airline and union representatives the day the strike began, and the group met May 3. National accepted the arbitration proposal the next day, and the union agreed to submit it to a vote.

Wages are a major issue in the dispute, with IAM seeking an hourly increase of 17 to 23 cents over a two year period. A company offer, which would have paid IAM members a maximum of $3.32 an hour, was rejected by the union, which said the increase was not in line with rates recently awarded IAM members on other major airlines.

## Wing Problem Blamed In Electra Accident

**Washington**—Civil Aeronautics Board found last week that the probable cause of the crash of a Northwest Airlines Lockheed Electra near Cannelton, Ind., on Mar. 17, 1960, was separation of the right wing in flight due to flutter induced by outboard nacelle oscillations.

In its conclusion, the Board found that although clear air turbulence may have contributed to the start of the flutter, such turbulence was insufficient to produce the nacelle damage necessary to make the destructive whirl mode self-sustaining. But the Board said that both Northwest Airlines and the Weather Bureau should have mentioned the clear air turbulence in their forecasts.

CAB concluded that there probably was unrecognizable prior damage in the wing, or in the wing and outboard nacelles, which made the effects of turbulence more critical than with an undamaged airplane. It suggested that a landing at Chicago on the day of the accident "may well have caused damage to the wing structure . . ."

# Eastern Shuttle Service Taps New Market

By Glenn Garrison

**New York**—Eastern Air Lines has tied up an appreciable fleet of piston planes and crews in its unique Boston-New York-Washington shuttle service, which it hopes will tap a significant new air travel market.

The low-fare, no-reservations experiment (AW Apr. 24, p. 42) began last week with weekday flights every two hours from each point between 8 a.m. and 10 p.m., and weekend flights on a less frequent schedule. The shuttle differs basically from other commuter type plans in that no seats were reserved in the 95-passenger 1049C and 1049 Constellations which make up the shuttle fleet. The airplanes simply stand by at flight time for loads to materialize. A boarding pass issued at the airport shortly before departure is the passenger's guarantee of a seat.

### Backup Aircraft

Initially, each schedule involves one aircraft plus a backup aircraft. If the first aircraft fills up, the second moves in for the overflow. This means that eight planes and crews must be ready at the three stations for each scheduled departure time. At 10 a.m., for example, there are four planes at New York; the regular Boston and Washington flights, plus the two backup planes. At the same hour, two aircraft will be ready at Boston and two at Washington for the New York runs plus backup.

Eastern is striving to simplify the shuttle service both to make it easy for the passenger and to cut costs for the airline. Officials say that success of the experiment will in some degree depend on convincing customers how easy it is to use the service.

No reservation facilities, with their attendant costs, are involved in the service. It is impossible to reserve a seat.

Boarding passes in the terminal are dispensed from machines, beginning 45 min. before each departure. The passenger writes his name and address on the pass—thus disposing of the passenger manifest problem in case of accident.

The passes are numbered, and when 95 are used, the flight is sold out and the backup plane is brought up.

The passenger can then go directly to his loading gate, where he surrenders his pass, has his baggage weighed, and pays overweight charges if necessary. The passenger puts his (unchecked) bag on a cart at the gate and boards his plane. If he doesn't already hold a ticket, he can pay his fare on the plane and get a receipt. But any ticket is acceptable, and if it was issued for a different type of service, he eventually will get a refund.

Paperwork and baggage weighing at the gate are handled by a flight attendant in the airplane's crew—saving additional personnel expense.

The boarding pass, incidentally, has a space on its reverse side for cancellation of any seat the passenger might hold on some other scheduled flight. This is aimed at reducing a potential no-show problem on other services.

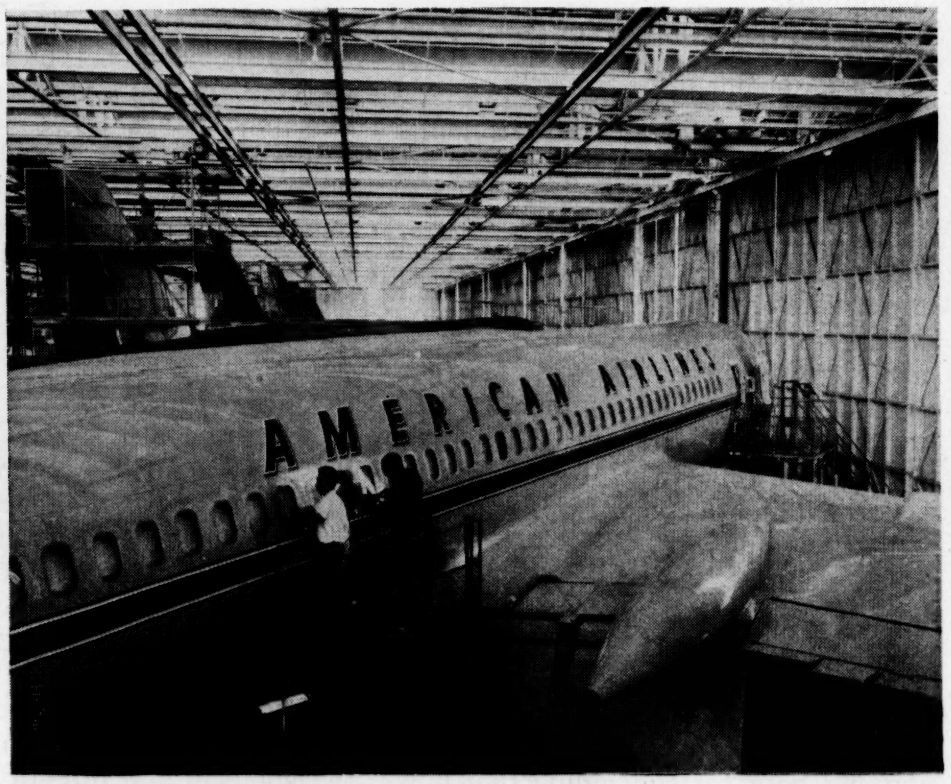
Eastern claims it would operate the backup flight for one passenger in the event 96 people showed up for a particular schedule. This would produce a record low load factor and involve two airplanes for one passenger; the plane carrying the passenger, and the airplane that would have to be dispatched from its destination to replace the backup aircraft for the next schedule.

Fares for the shuttle are $10.91 between New York and Boston and $12.73 between New York and Washington, excluding tax. This is a 27% reduction from standard first-class fares, and only slightly higher than rail coach fares.

### La Guardia Operation

Eastern has turned its La Guardia Airport operation almost entirely over to the shuttle experiment. Formerly 27 daily departures were scheduled from the airport; there are now 21, all but five of which are shuttle flights. The other services have been shifted to Newark and Idlewild.

A separate terminal at La Guardia will handle Eastern's flights beginning next month. The $525,000 facility, under construction inside the airline's hangar, will provide its own access roads and parking lots and will be convenient to the air shuttle aircraft on the apron. The terminal door is 150 ft. from the




**990 Has American Airlines Markings**

**American Airlines will begin taking delivery of the first of 25 Convair 990s in November. Here, Convair's number four 990 is painted in airline markings. Two 990s are in flight test, one in static test.** **(See p. 45.)**

planes. The facility is temporary, however, pending completion of the airport's new general passenger terminal now under construction.

Eastern has set up what it calls a miniature airline operation at La Guardia to handle the shuttle, with a project manager in charge. There is direct telephone contact with Boston and Washington and a separate dispatching and customer service setup for the shuttle.

### Experimental Service

The service is strictly an experimental effort to tap traffic not now moving by air or moving at all. Its tariff carries an Oct. 28, 1961, expiration date, and traffic results will determine whether it will be continued, allowed to expire, or canceled before that date. The high-density New York-Boston and New York-Washington markets were considered ideally suited for such an experiment.

Eastern told the Civil Aeronautics Board that a 50% load factor should meet all fully allocated costs of the service, including additional crew and other expenses of the backup flights. The airline planned to use excess piston aircraft in this service last fall, but was delayed by the operating confusion at La Guardia connected with the rehabilitation work at that airport.

A sidelight on the temporary conditions at La Guardia and the shuttle service: Northeast Airlines' passengers must move past Eastern's counter area to get their boarding gates. They therefore pass big signs advertising the lower fares to Boston and Washington. Some of them, according to Eastern, have peeled off the Northeast line and taken the shuttle.

Shuttle passengers at La Guardia are provided with supermarket type carts to roll their bags out to the loading gates.

### Reduced Fare Plan

Reduced fare, no reservation plans of other airlines—Allegheny and Trans World Airlines—apply on aircraft which also carry passengers with reserved space at higher fares. On Eastern's own "airbus" services to Florida from St. Louis, Pittsburgh and Cleveland, tickets must be bought beforehand and the ticket constitutes the reservation, redeemable up to 24 hr. before departure.

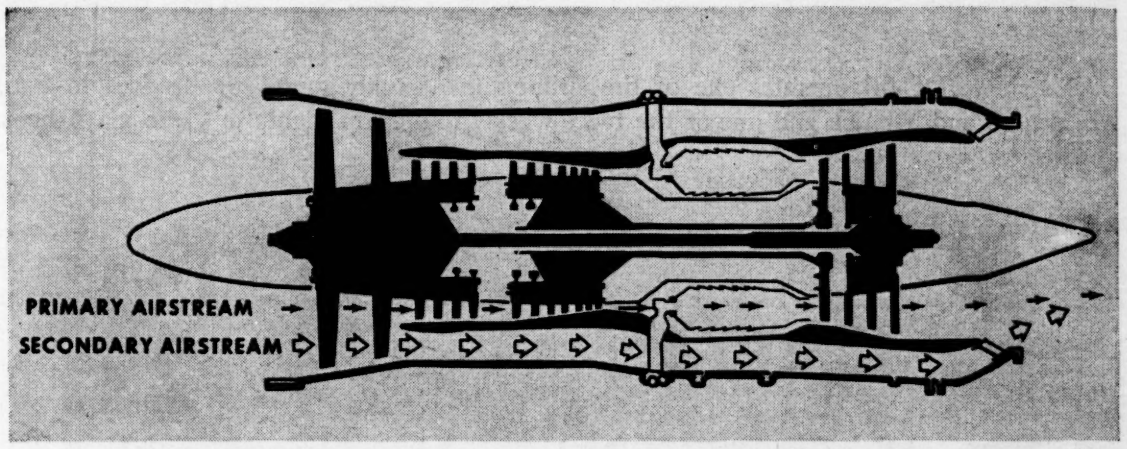
Load factors in the "airbus" service are building up, according to Eastern. For the three routes, load factors averaged just under 50% for December, January and February. Figure for March was 56% and for April, 64%. Two daily round trips are scheduled from Pittsburgh, two from Cleveland, and one from St. Louis. Initial expiration date of Apr. 20, 1961, for this service has been extended through Oct. 28, 1961.

The airline's belief that "airbus" is generating a new market is bolstered by results of an Eastern survey which indicated that 9% of the passengers were first riders in an airliner—three times as high a percentage as Eastern's system average, according to the airline. Some 22% of the passengers formerly used automobiles on their Florida trips, and 38% gave "economy" as their main reason for using the service (AW May 1, p. 38).

Eastern has estimated that during January it averaged 47.2 passengers per "airbus" plane mile with $1.86 of passenger revenue per plane mile, and total revenue $1.95 per plane mile. Direct aircraft costs for the 1049C equipment in the service were about $1.40 per mile. The service, the airline said, is meeting all out-of-pocket costs and making a substantial contribution to overhead.

Also in January, Eastern's Pittsburgh-Miami "airbus" passengers exceeded air-coach passengers of a year previous by 18.9%. Total was up 5.5% in the Cleveland-Miami market and up 11% in the St. Louis-Miami market. During the same month, Eastern's system revenue passenger miles and passenger boardings decreased by 3.8% and 8.5% respectively.

In the New York-Boston-Washington shuttle service, Eastern now is offering a daily minimum of 1,000 seats at each station. Planes are available to more than double this total if traffic warrants. In the addition to the backup planes, plans are to schedule extra sections if business builds up as hoped.




**PRATT & WHITNEY'S JT8D turbofan engines will power Boeing's 727 transport. Each of the three engines, mounted at the rear of the short- to medium-range aircraft, develops 14,000 lb. of thrust. Eastern, United and Lufthansa airlines have placed orders for the aircraft. Air, passing through the two large fans of the P&W engine, is split into two streams. Primary stream spurts through the compressor, combustion and turbine sections in the conventional jet manner but slightly more than half of the air (shown by larger arrows in diagram above) flows through annular ducts surrounding the conventional fuel-burning engine.**

# Full-Length Bypass Duct Increases JT8D Efficiency, Lowers Noise

Pratt & Whitney Aircraft's JT8D turbofan engine, scheduled to power the Boeing 727, features a full-length annular bypass duct which is a departure from the short-length fan discharge ducts of other P&W turbofan engines.

This type of layout, pioneered by Rolls-Royce in its Conway series of engines, moves the cooler bypass air outside the engine and finally mixes it with the hot central core of the gas generator exhaust. Matched mixing of the two streams at the exhaust nozzle minimizes noise and maximizes engine efficiency.

Rating of the JT8D is 14,000 lb. takeoff thrust.

Engine runs on the test stand are scheduled currently, and later this year the company will start flight tests with the engine mounted on suspension below the bomb-bay of one of the P&W flying testbeds—a North American B-45.

Boeing will receive first prototype engines next year, and production powerplants during the first half of 1963.

The engine's two fan stages are integral with a four-stage low-pressure compressor. This rotating component is driven through a central shaft by the last three stages of the four-stage turbine.

The seven-stage high-pressure compressor is driven by the first-stage turbine.

Over-all compression ratio of the engine is 15.5:1. Bypass ratio is 1.1:1.

Dry weight of the JT8D is 2,988 lb. Over-all length of the engine is 122.5 in. (slightly over 10 ft.) and diameter is 42½ in. These figures show the turbofan powerplant to be only slightly larger in diameter than the J57 turbojet, and almost four feet shorter.

# Yugoslavian Ca

By Edith Walford

**Belgrade**—JAT, Jugoslavenski Aerotransport, the national Yugoslav airline, plans to introduce its first jet services by 1963.

No decision has been reached as to the type aircraft to be chosen or the one best suited to fit the small carrier's needs and pocketbook, but, with Belgrade's new airport capable of accommodating modern turbojet equipment scheduled for completion by the end of this or the beginning of next year, the question should be settled within the near future.

According to JAT's technical director, Ing. R. Radojkovic, the new jet transports will be placed into service on JAT's major medium-range routes such as Cairo and Paris. Convair 440 and Douglas DC-6B aircraft now operate the five times a week round-trip service from Belgrade to Paris via Zagreb and Munich.

The new jets also will serve route extensions such as Belgrade-Zagreb-Vienna-Frankfurt/Main. This twice weekly service was expected to be increased beginning May 6 to three times a week. The new flight, which will not stop at Vienna, will be extended from Frankfurt to London and will operate every Saturday, returning to Belgrade on Sunday.

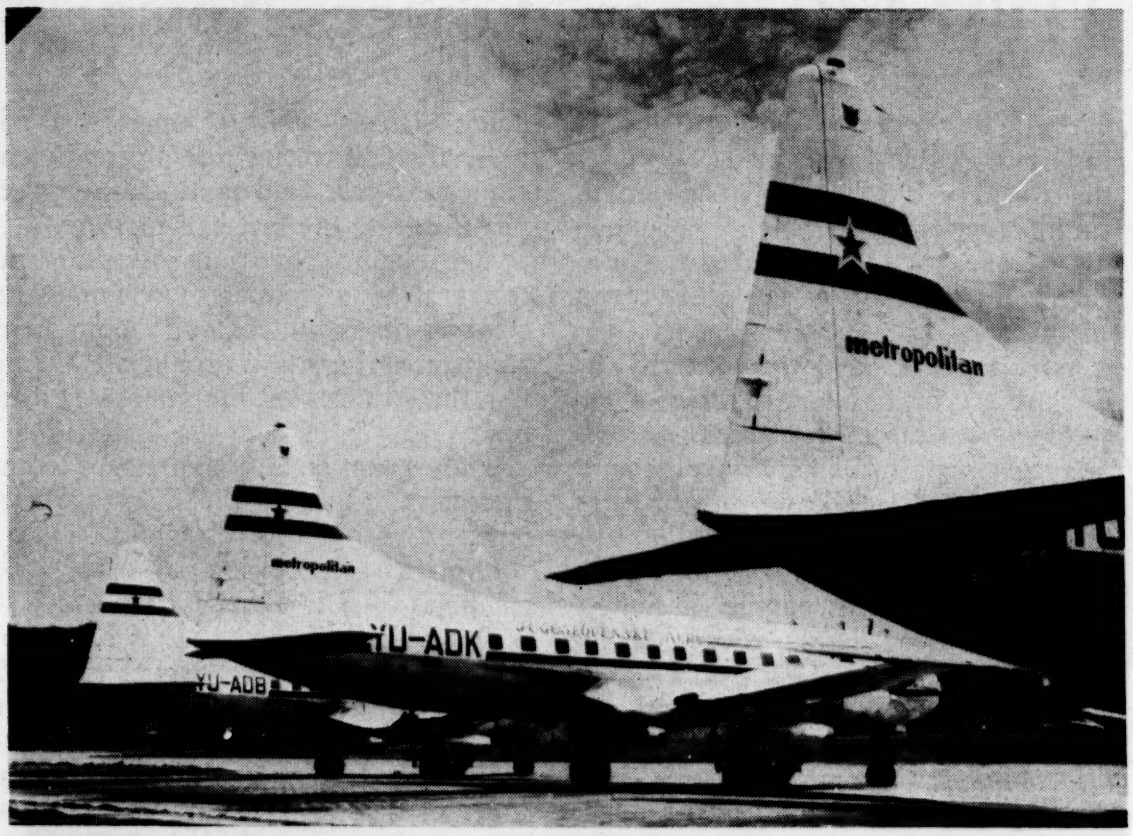
JAT, which flies to both the East and the West and operates U.S. and Russian equipment, is working on plans aimed at gaining a large share of the rapidly growing air traffic in Europe as one means toward boosting the country's much needed trade and tourism after the havoc created by two wars. First step toward this goal was taken in 1958 when development began on the new international airport at Banzaniska Kosa, approximately 11 mi. from the center of Belgrade. At an estimated cost of $8.2 million at the official exchange rate of 750 dinars to the dollar and covering an area of about 700 acres with room for expansion, the project will replace the outdated, temporary facilities at Zemun Airport, located about 2½ mi. from Belgrade.

One of the two 10,000-ft.-long main runways planned for the new airport, most of the taxiways and apron are completed and erection of the main buildings, including control tower, hangars, servicing and maintenance shops, is well under way.

Jugoslavenski Aerotransport was established at the end of 1946 and began operations early in 1947 with a handful of Douglas DC-3s. The company is state-financed, but JAT officials here say they are given a free hand in making

**JAT's** single DC-6B operates one of the airline's five weekly round-trip services to Paris via Zagreb and Munich and one of the twice weekly round-trip flights to Cairo via Athens.

**YUGOSLAV AIRLINES'** Convair 440 lands at Cairo Airport. JAT plans to purchase additional 440s in the near future to replace its aging Douglas DC-3 fleet which, together with 26-seat Soviet Ilyushin-14s, serve the carrier's domestic route network.




**TWO** Convair 440s and one Convair 340 serve JAT's international European network.

# n Carrier to Introduce Jet Service by 1963

decisions and determining the carrier's general policy.

Total staff, including 80 pilots and about 30 stewardesses, all of Yugoslav nationality, numbers 1,500 at present. Working hours are unusual—from 6 a.m. until 2 p.m., with a half-hour lunch break six days a week. JAT says this schedule had been introduced to comply with the average Yugoslav employe's desire to devote part of his day to private pursuits.

Ing. D. Mandic, deputy technical director of JAT at Belgrade, says that skilled labor is hard to find and presents a serious problem to the airline. Other industries, the building industry in particular with large postwar reconstruction programs in full swing all over Belgrade, are absorbing a great number of workers and need more. JAT says it is forced to draw many unskilled men from the neighboring countryside, who are not easily adaptable to modern living and working conditions, quite apart from up-to-date repair techniques. The training of these at company expense is consequently a laborious, time-consuming and therefore costly affair.

JAT's fleet is composed of 13 Douglas DC-3s, 6 Ilyushin-14s, 1 Douglas DC-6B, 2 Convair 440 Metropolitans, 1 Convair 340 and 10 Stearman Boeing primary trainers.

The Douglas DC-3s and Ilyushin-14s serve JAT's domestic network over 26 different schedules this year as opposed to 25 last year, serving 12 airports. Seven of these are open on a year-round basis, the remaining five only in the summer season, but improved airstrips and airport facilities at some of these will soon allow them to be included in JAT's year-round flight schedules.

Belgrade, Zagreb and Titograd are Yugoslavia's main airports, but by next year further development of Dubrovnik Airport, near one of Yugsoslavia's most popular seaside resorts on the Adriatic coast, and the improvements planned to be completed by 1962-1963 at Split, Skopje and Sarajevo should be far enough along to accommodate 440s.

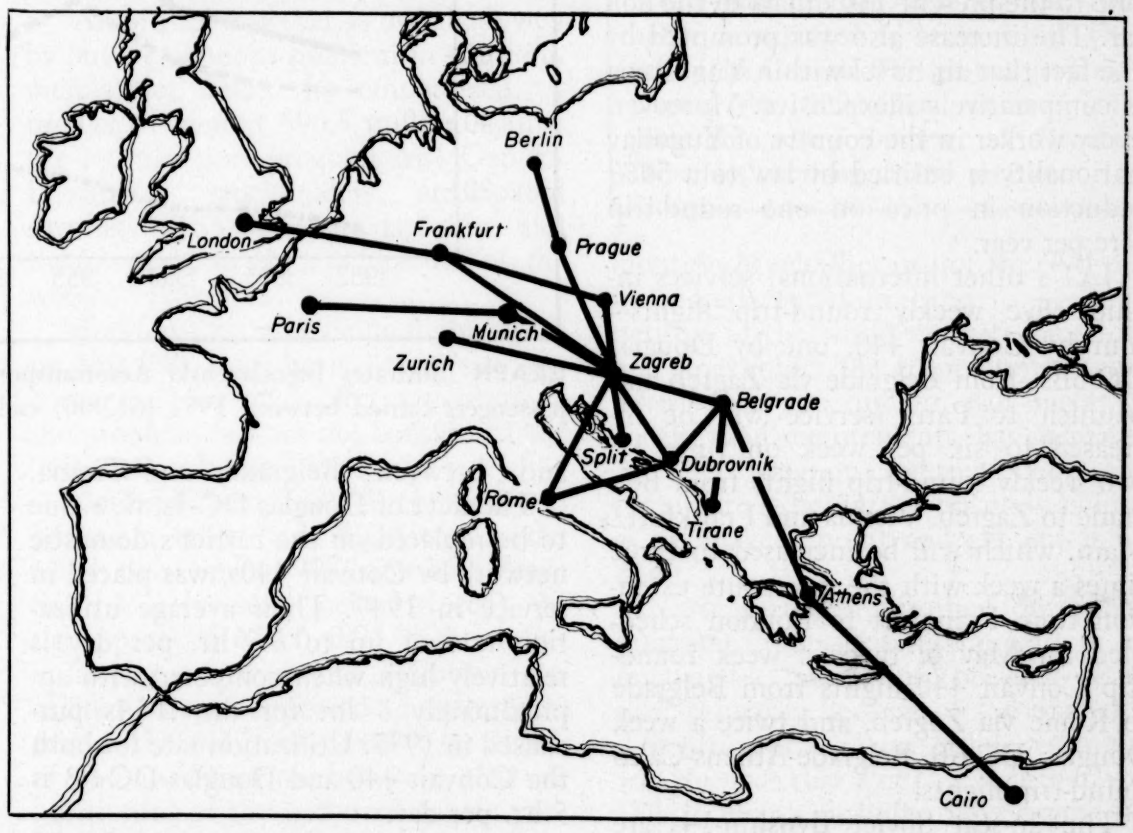
The carrier's aging Douglas DC-3 fleet is gradually to be phased out and JAT says it plans to buy additional Metropolitans to replace the DC-3s on all its domestic routes as soon as sufficient airfields with suitable installations are available to warrant such an investment.

This is only the first step in the airline's airport development program now being worked out to keep step with the steady expansion envisaged over the next few years. JAT hopes to obtain permission soon to use or take over several military airports. Details are now being negotiated with Yugoslav air force officials.

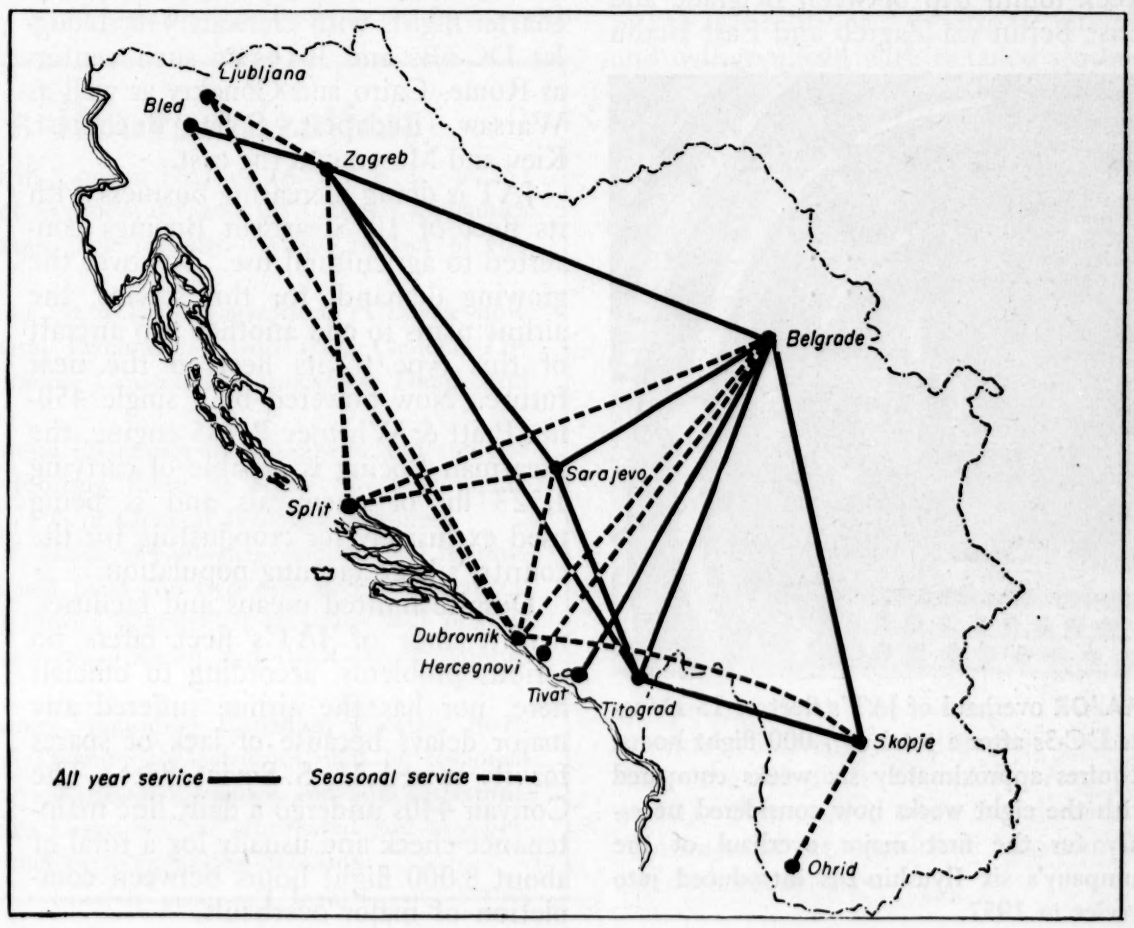
Thus far a total of 10 foreign carriers from both East and West serve Belgrade, JAT's home base, on regular scheduled flights—Swissair, Austrian Airlines, CSA Czechoslovak Airlines, Aeroflot, East German Lufthansa, LOT, BEA, Tarom (Rumania) Malev (Hungary) and Tabso (Bulgaria).

Despite restricted means and a continuing shortage of skilled workers, the Yugoslav carrier has shown slow but steady progress over the past few years. Compared with 1952 when 52,000 passengers were flown on its domestic network, 160,000 passengers were carried last year. On the carrier's international routes, 9,000 were flown in 1952, 51,000 in 1960.

Major year-round domestic services are from Belgrade to Zagreb and Ljubljana, Belgrade-Sarajevo, Belgrade-Titograd, Belgrade-Tivat, Belgrade-Skopje




**DOMESTIC** (below) and international (top) routes flown by the Yugoslav carrier include a new round-trip Convair 440 route extension to London from Frankfurt/Main which was scheduled to be introduced on May 6.



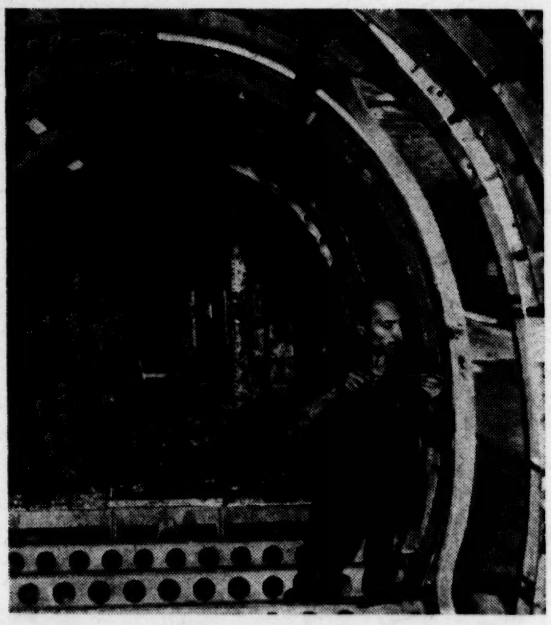
and Belgrade-Sarajevo-Titograd route.

During the peak summer period from mid-June to mid-September, DC-3s also operate once a week round-trip services from Belgrade to Split, Zagreb and Vienna, twice a week between Belgrade, Dubrovnik and Rome and twice a week from Belgrade to Zurich via Zagreb. One of these two weekly flights to Zurich is nonstop and is operated with Convair 440s.

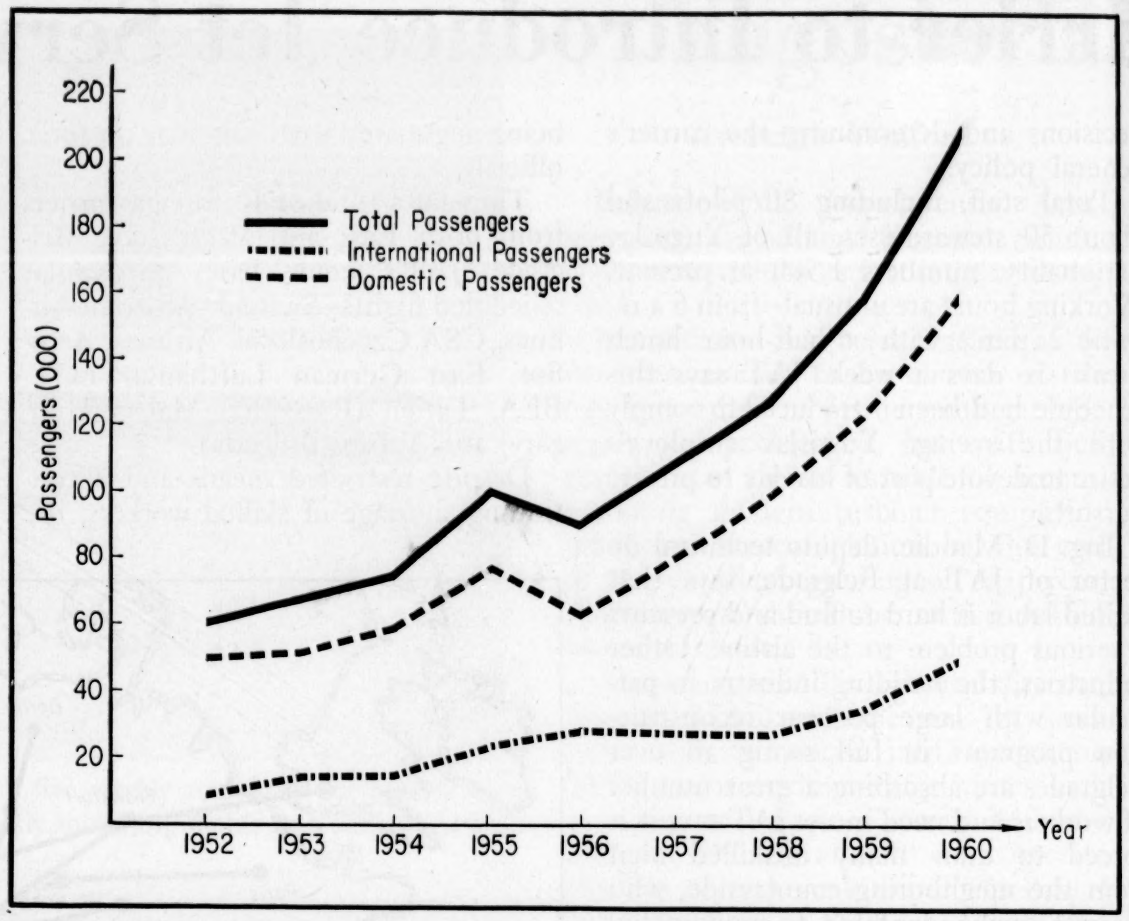
On Apr. 1, JAT introduced a 15% fare increase on its domestic routes which it says became necessary in order to balance the recent adjustment made in the dollar exchange rate from 600 to one to the present 750 dinars to the dollar. The increase also was prompted by the fact that air travel within Yugoslavia is comparatively inexpensive. Moreover, every worker in the country of Yugoslav nationality is entitled by law to a 50% reduction in price on one round-trip fare per year.

JAT's other international services include five weekly round-trip flights—four by Convair 440, one by Douglas DC-6Bs—from Belgrade via Zagreb and Munich to Paris (service will be increased to six per week on June 1); two weekly round-trip flights from Belgrade to Zagreb, Vienna and Frankfurt/Main, which will be increased to three times a week with the new route extension from Frankfurt to London scheduled for May 6; twice a week round-trip Convair 440 flights from Belgrade to Rome via Zagreb, and twice a week Douglas DC-6B Belgrade-Athens-Cairo round-trip flights.

The 26-seat Soviet Ilyushin-14s are operated primarily on JAT's east European routes of which there are only two year-round scheduled services—once a week round trip between Belgrade and East Berlin via Zagreb and East Berlin



**MAJOR overhaul of JAT's fleet of 13 Douglas DC-3s after a total of 7,000 flight hours, requires approximately six weeks compared with the eight weeks now considered necessary for the first major overhaul of the company's six Ilyushin-14s introduced into service in 1957.**




**GRAPH illustrates Jugoslavenski Aerotransport's steady progress in terms of number of passengers carried between 1952 (61,000) and 1960 (211,000).**

and between Belgrade and Tirana.

The fleet of Douglas DC-3s, now due to be replaced on the carrier's domestic network by Convair 440s, was placed in service in 1947. Their average utilization rate of up to 5.5 hr. per day is relatively high when compared with approximately 3 hr. for the Il-14s purchased in 1957. Utilization rate for both the Convair 440 and Douglas DC-6B is 5 hr. per day.

There is no demand thus far for air taxi service in Yugoslavia, JAT officials say, but, during the peak tourist season, the airline does operate occasional charter flights with Convair 440, Douglas DC-6Bs and Il-14s to such centers as Rome, Cairo and Conakry as well as Warsaw, Budapest, Sofia, Bucharest, Kiev and Moscow to the east.

JAT is doing increasing business with its fleet of 10 Stearman Boeings converted to agricultural use. To cover the growing demands for this service, the airline plans to add another two aircraft of this type to its fleet in the near future. Now powered by a single 450-hp. Pratt & Whitney R-985 engine, the Stearman Boeing is capable of carrying 1,323 lb. of chemicals and is being used exclusively for cropdusting for the country's large farming population.

Despite limited means and facilities, maintenance of JAT's fleet offers no serious problems, according to officials here, nor has the airline suffered any major delays because of lack of spares for its mixed U. S.-Soviet fleet. The Convair 440s undergo a daily line maintenance check and usually log a total of about 8,000 flight hours between completion of major overhauls.

The airline has recently experimented with a form of progressive maintenance on the Douglas DC-6B, which has proved so satisfactory that it now plans to adapt its Convair 440s to the same procedure.

Previously, JAT's conventional maintenance system worked like this:

- **DC-3:** After 10 flight hours, first check is made between flights (7 man hours), second check after 65 hr. lasting one day (120 man hours), third check after 200 hr. requiring two days (200 man hours), fourth check after 800 hr. requiring three days (800 man hours), and major overhaul after a maximum of 7,000 hr. (10,000 man hours requiring 4-to-6 weeks). The airline also attempts to carry out major overhauls during the slack winter season and never to have more than one or two aircraft out of service at any one time.
- **Il-14:** First check is made after 10 hr. (8 man hours), second after 25 hr. (50 man hours), third after 50 hr. (150 man hours), fourth after 100 hr. (300 man hours), fifth after 300 hr. (350 man hours) and major overhauls after 2,000 hr. (15,000 man hours). JAT officials declined to specify why the Il-14s require more frequent inspections than the older DC-3 fleet.
- **Convair 440:** First check after 100 flight hours (150 man hours). Major overhaul cycle begins at 1,000 hr., is completed after 8,000 hr. (2,000 man hours).
- **Douglas DC-6B:** First check after 100 flight hours (250 man hours). Major overhaul begins at 1,200 flight hours and is completed after 10,000 hr. (2,500 man hours).

# Pace Predicts Additional Losses From Convair 990 Development

**Dover, Del.**—General Dynamics stockholders can expect further losses this year from the Convair Division transport program, primarily stemming from development problems with the Convair 990, Board Chairman Frank Pace, Jr., told the annual meeting.

Pace said that despite the apparent success of recent flight tests of a modified 990, solving the 990 design difficulties by the new December certification deadline remains the major problem currently faced by General Dynamics. His remarks on the 990 program were seconded by C. R. MacBride, executive vice president and acting president of the Convair Division.

Board of directors was re-elected by a wider margin than last year, and Pace cited this as "clear evidence" of the stockholders' "interest and support" of General Dynamics management.

Reviewing the progress of other General Dynamics divisions, Pace cited Canadair, Electric Boat, General Atomic, G. D. Electronics and Convair Astronautics, as being among the most valuable to the corporation from a profit and growth standpoint.

Electric Boat, manufacturer of submarines, "has contributed substantially" to the General Dynamics corporate earnings and can be expected to improve its position because of the increasing number of Polaris submarines being ordered, Pace said.

General Atomic has "exceeded all expectations," Pace said, and is now one of the two leaders in the commercial reactor field. He added, however, that a "real return" from this division can not be expected for at least five years.

G. D. Electronics has absorbed Stromberg-Carlson. He said that since Stromberg eliminated its television and radio production activities, its production of other electronic equipment has doubled.

Convair Astronautics did nearly twice the business last year that the Convair Division did the year it was acquired by General Dynamics, said Pace.

"All of this, however, is overshadowed by our tremendous problem in the commercial jet field," he emphasized. A pre-tax writeoff at $96.5 million against the jet transport program cost General Dynamics' stockholders anticipated earnings of $5 per share last year, and the corporation is "still not out of the woods," Pace said.

Modifications now being flight tested on the 990 have been "extremely encouraging" and may offer a solution to the problem, but are not considered the "ultimate solution" Pace said.

MacBride later said the corporation's optimism stems from flight tests under which two Convair 990s now have flown their $V_{ne}$ (velocity never exceed) design speed of Mach 0.91 without any indication of structural vibration and oscillation that appeared in early flight tests. He did not reveal full details of the modification but said that repositioning of the outboard engine pods 27 in. aft was a major part.

Time has been the biggest concern of General Dynamics in its entire commercial jet program, Pace said, pointing out that the corporation is facing the question of whether or not the 990 can be manufactured in time to be competitive in the world market. Pace told one stockholder the corporation is confident that the aircraft will meet its certification requirements, has increased its sales program internationally and intends to "stay in the business as long as we make a profit and get out if we don't."

Unforeseen delays in the Convair 880 program also placed this aircraft in an unfavorable marketing position, Pace said, primarily because of the financing difficulties of a major airline customer and the fact that Pratt & Whitney was able to offer a turbofan type engine before General Electric, which manufactures the CJ-805-23 turbofan powerplants used on the Convair 990.

General Dynamics still is interested in the feasibility of a supersonic aircraft and will go ahead with detailed studies, Pace said, since Convair-built aircraft now hold most of the military speed records and the B-58 Hustler is considered a good testbed for supersonic transport development.

"However," Pace cautioned, "there is still the question of are we going to be caught in the same trap as with the commercial jet program. I don't think we'll go this alone on the stockholders' money. We need a consortium of airlines or government backing."

MacBride noted that Convair feels the 990 can, with modifications, be utilized economically on either medium or long-haul routes, but the division has studied all types of design and has "definite plans" for a new aircraft proposal competitive with the Boeing 727. This is understood to be a different aircraft than the Convair 60 (AW Aug. 1, p. 40). Pace added that the division's "commercial jet problem" has complicated these plans.

## Hilton Hotel Deal

General Dynamics Corp. may be faced with a $25-million outlay next month to the Hilton Hotel Corp., growing out of a transaction between Hilton and the Crown family which sold Material Service Corp. to General Dynamics last year.

The Crown interests purchased the Beverly Hilton Hotel in Los Angeles and leased it back to Hilton, using as part payment 366,234 shares of General Dynamics convertible preferred stock, part of the stock the Crown family received in payment for Material Service.

Hilton has the option to sell the stock to General Dynamics at $66 a share between June 15 and June 30 and the option is expected to be exercised. On top of its Convair 990 jet transport expenses, the $25-million expense will place an added burden on General Dynamics' working capital position.

## General Dynamics Reorganization

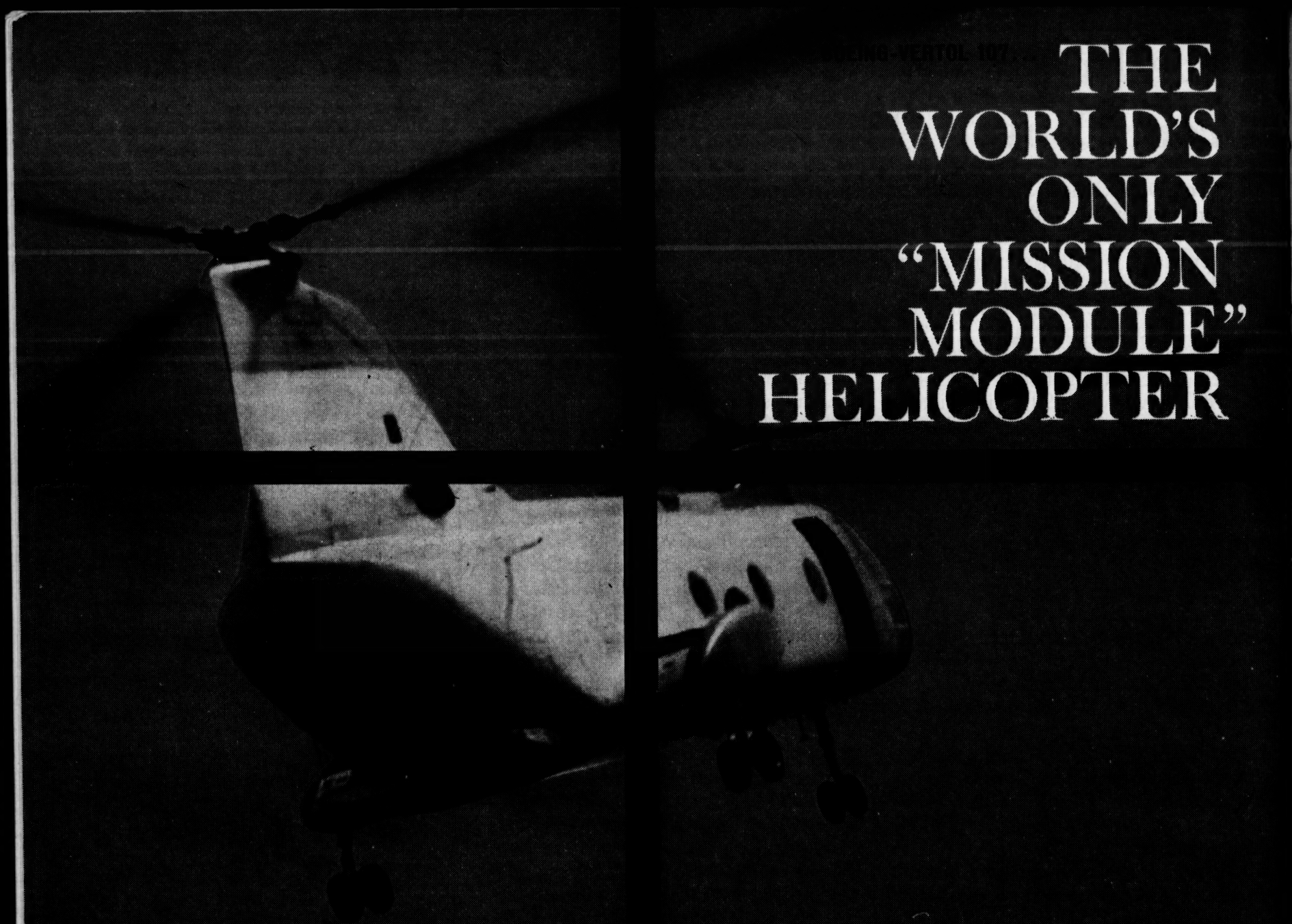
General Dynamics' predicted shakeup of its Convair Division (AW Apr. 17, p. 25) took place last week with the formation of five new divisions of General Dynamics and grouping of all divisions into two major organizations. Major impact of the changes:

- Elimination of the historic Convair name from the organization. Convair now will become five separate divisions: General Dynamics/Astronautics; General Dynamics/Ft. Worth; General Dynamics/Pomona; General Dynamics/San Diego, and General Dynamics/Daingerfield.
- Moving operational headquarters of General Dynamics to San Diego and transfer of General Dynamics president Earl D. Johnson there for more direct corporate supervision of operations that account for 75% of General Dynamics business.

C. Rhoades MacBride, who replaced J. V. Naish as Convair president, will become one of two executive vice presidents who will head the two new division organizations, both of whom report directly to Johnson. MacBride's divisions will include the five new ones created from the Convair organization and the General Atomic Division.

The other divisions of General Dynamics, including Canadair, Electric Boat, General Aircraft and Leasing and General Dynamics/Electronics, will be responsible to W. P. Gullander, former executive vice president-finance and administration.

The former Convair general office at San Diego will be eliminated and key personnel will be reassigned to the corporate staff or to operating divisions.



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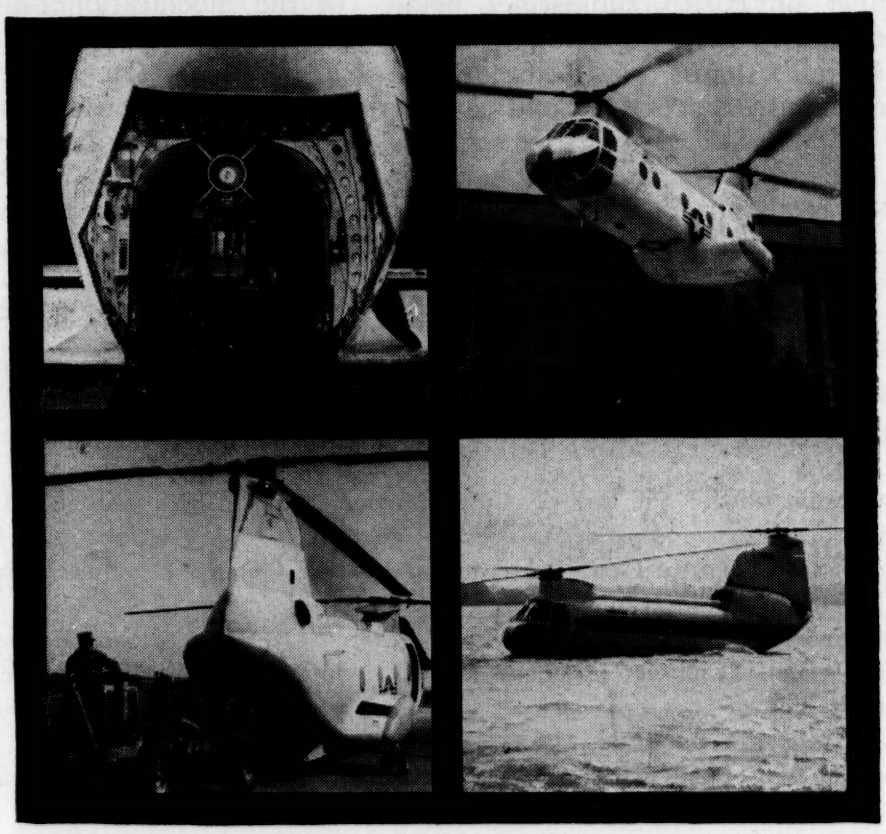
For the Air Force alone, the Boeing-Vertol 107 can perform search and rescue, security patrol, photo mapping and drone recovery. And in missile site support, the 107's twin-turbine speed, its tandem-rotor stability and all-weather, all-terrain capabilities assure around-the-clock delivery of payloads ranging from personnel to a cargo load of 5000 pounds or more carried internally, externally or even half-in, half-out.

These features demonstrate the all-mission, all-service capabilities of the Boeing-Vertol 107... the logical, versatile addition to today's fast-striking Army, Navy, Air Force and Marines.



VERTOL DIVISION
MORTON PENNSYLVANIA
BOEING

# Capital Reports Officers' Salaries

**Washington**—Following is a list of Capital Airlines officers' salaries, bonuses and indirect compensation, expenses, and stock holdings for the year ending Dec. 31, 1960, as filed with the Civil Aeronautics Board:

**D. H. Baker**, president and director, $56,000 salary, 300 shares of common stock, $4,293 expenses; **W. H. Johnson**, senior vice president and director, (resigned Oct. 15, 1960) $36,987 salary, 100 shares of common stock, $7,808 expenses; **R. G. Lochiel**, senior vice president and director, $32,666 salary, 4,000 shares of common stock, $1,613 expenses; **M. Whitlock**, senior vice president, $29,306 salary, no stock, $619 expenses; **R. J. Wilson**, vice president, $25,013 salary, 198 shares of common stock, $1,415 expenses; **H. Dever**, vice president and secretary, $19,786 salary, 900 shares of common stock, $2,558 expenses; **R. Q. Chalfant**, vice president, $16,333 salary, three shares of common stock, $2,681 expenses.

**G. W. Hobbs**, vice president (resigned Sept. 15, 1960) $18,356 salary, no stock, $1,441 expenses; **J. G. Mahoney**, vice president (resigned Nov. 14, 1960), $17,916 salary, no stock, $4,304 expenses; **R. W. Hardesty**, vice president, $19,196 salary, 100 shares of common stock, $812 expenses; **E. Raymond**, assistant vice president, $14,371 salary, no stock, $277 expenses; **S. T. McAlister**, assistant vice president, $14,480 salary, no stock, $951 expenses; **A. M. Gould**, assistant vice president, $13,066 salary, 36 shares of common stock, $2,021 expenses, $15,000 debt securities;

**O. Estes**, assistant treasurer, $14,000 salary, no stock, $527 expenses; **W. B. Smith**, assistant secretary, $10,412 salary, no stock, $444 expenses; **J. B. Franklin**, senior vice president, (resigned June 1, 1960), $19,886 salary, no stock, $355 expenses; **A. H. Norling**, senior vice president (resigned Aug. 12, 1960), $11,946 salary, no stock, $521 expenses; **J. B. Andersen**, assistant vice president, (June-Aug. 15, 1960), $10,448 salary, no stock, $1,002 expenses.

**G. Y. Billard**, director, (from June, 1960), no salary, no stock, no expenses, $70,000 debt securities; **W. V. Couchman**, director, no salary, no stock, $400 bonus and indirect compensation; **J. F. Cullman**, director, no salary, no stock, $300 bonus and indirect compensation; **D. L. Frawley**, director, no salary, 2,000 shares of common stock, $300 bonus and indirect compensation; **G. R. Hann**, director, no salary, 45,832 shares of common stock, $300 bonus and indirect compensation; **C. T. Johnson, Jr.**, director, no salary, 294 shares of common stock, $300 bonus and indirect compensation; **A. F. Kroeger**, director, no salary, 1,000 shares of common stock, $600 bonus and indirect compensation; **C. B. Monro**, director, no salary, 152 shares of common stock, $700 bonus and indirect compensation; **C. H. Murchison**, director, no salary, 80,532 shares of common stock; **T. D. Neelands, Jr.**, director, (from May, 1960), no salary, no stock; **J. R. Stockton**, director, no salary, no stock, $500 bonus and indirect compensation.

Following firms were paid for services rendered during 1960; **Adair, Ulmer, Murchison, Kent and Ashby**, legal, $179,612; **Kenyon and Eckhardt, Inc.**, advertising, $1,847,725; **Lybrand, Ross Bros. and Montgomery**, management consultant, audit and tax, $49,040; **Art Designers, Inc.**, advertising art, $44,770; **Chase Manhattan Bank**, pension trustee, $15,546; **Bankers Trust Co.**, debenture trustee, $10,431; **Colortone Press**, advertising art, $11,248; **Lippincott and Margoulis**, industrial design, $32,288; **Manufacturers Trust**, transfer agent, $25,186; **M. J. Vander Ploeg**, (Holand) management consultant, $6,121; **Wallace Clark and Co., Inc.**, management consultant, $28,796.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# Airline Income and Expenses—1960

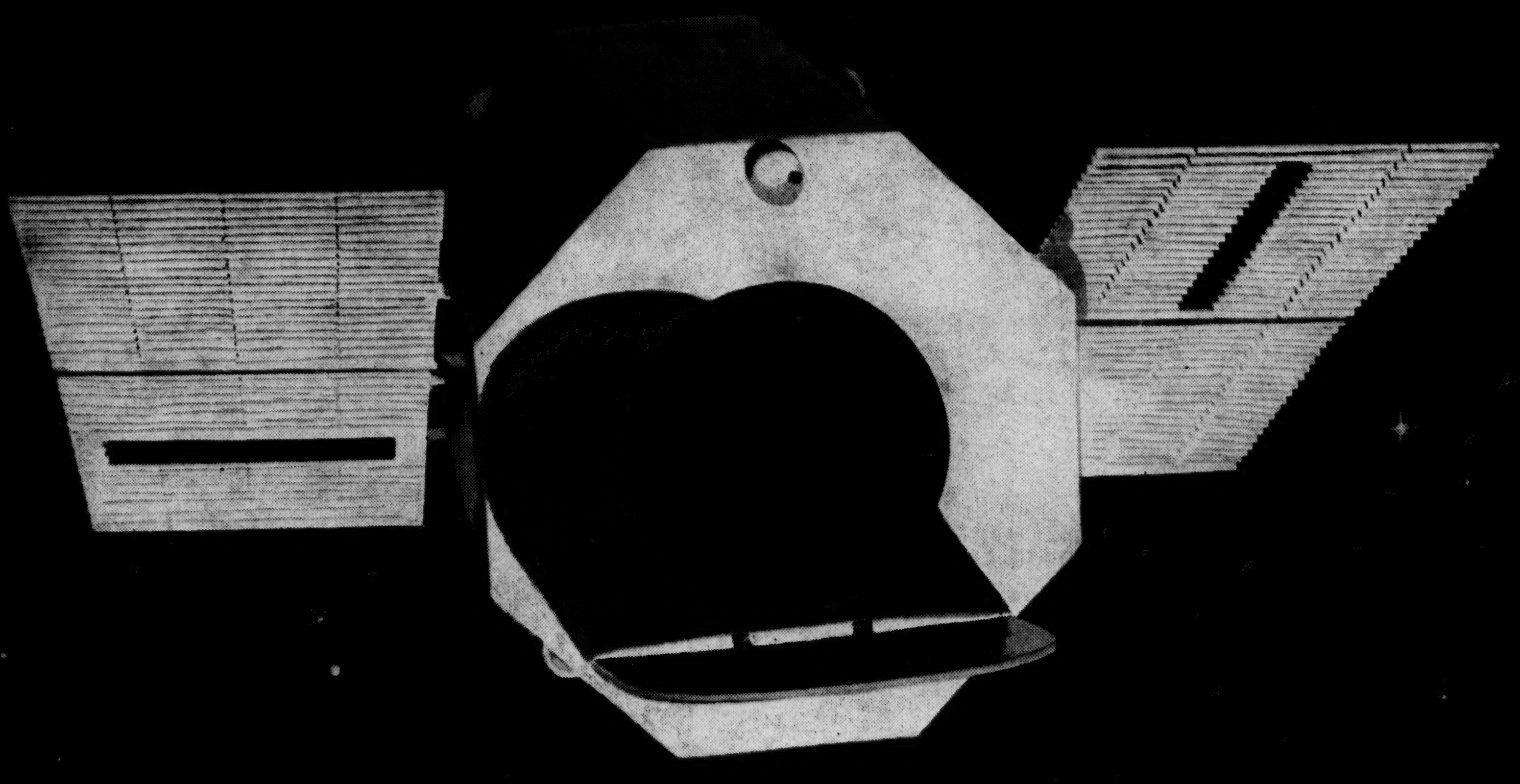
(IN DOLLARS)

| | Passenger Revenue | U. S. Mail | Express | Freight | Charter | Total Operating Revenue | Total Operating Expenses | Net Income Before Taxes |
|---|---|---|---|---|---|---|---|---|
| **DOMESTIC TRUNK** | | | | | | | | |
| American | 377,167,436 | 7,896,514 | 4,729,991 | 24,236,150 | 1,754,041 | 421,605,040 | 396,883,573 | 22,406,967 |
| Braniff | 68,983,544 | 1,981,705 | 801,013 | 2,124,845 | 825,590 | 75,751,093 | 72,447,027 | 2,212,543 |
| Capital | 96,845,390 | 2,381,768 | 1,543,288 | 1,726,844 | 303,493 | 104,239,447 | 110,581,018 | —6,341,541 [2] |
| Continental | 56,735,907 | 956,541 | 513,377 | 1,255,389 | 291,918 | 61,047,582 | 54,635,481 | 3,531,420 |
| Delta | 117,680,613 | 2,247,507 | 1,501,322 | 4,005,580 | 533,103 | 128,376,357 | 119,230,814 | 7,347,760 |
| Eastern | 243,650,462 | 5,343,592 | 2,613,958 | 5,489,881 | 299,544 | 263,796,292 | 269,662,608 | —7,846,429 |
| National | 59,903,876 | 1,258,221 | 333,015 | 2,122,156 | 1,428,068 | 66,427,518 | 73,308,093 | —4,949,862 |
| Northeast | 35,366,220 | 568,964 | 269,172 | 886,925 | 59,104 | 37,930,921 | 43,959,960 | —7,979,259 |
| Northwest | 75,584,231 | 2,510,188 | 1,330,609 | 4,611,887 | 409,953 | 86,183,354 | 84,198,830 | 738,849 |
| Trans World | 251,641,114 | 6,291,036 | 3,312,369 | 9,573,514 | 1,645,738 | 277,130,800 | 278,013,121 | —1,166,368 |
| United | 313,105,558 | 12,006,667 | 4,319,410 | 17,467,030 | 2,418,938 | 355,881,177 | 346,451,911 | 11,076,385 |
| Western | 59,775,847 | 1,327,914 | 518,867 | 1,290,908 | 444,474 | 64,267,052 | 58,413,210 | 5,305,284 |
| **INTERNATIONAL** | | | | | | | | |
| American | 5,809,806 | 42,878 | 3,663 | 617,627 | 9,412 | 6,877,252 | 7,527,482 | —648,925 |
| Braniff | 9,233,480 | 247,422 | ..... | 605,396 | 50,908 | 10,799,609 | 11,497,381 | —890,581 |
| Caribbean Atlantic | 3,219,741 | 34,223 | ..... | 142,133 | 21,266 | 3,507,782 | 3,196,255 | 314,397 |
| Delta | 2,975,431 | 37,272 | ..... | 94,833 | 2,432 | 3,284,184 | 4,165,589 | —960,682 |
| Eastern | 27,936,754 | 569,758 | ..... | 650,585 | 125,555 | 30,008,094 | 29,495,235 | 60,886 |
| Mackey | 1,670,800 | ..... | 7,874 | 38,147 | 269,292 | 2,013,923 | 2,013,923 | 14,369 |
| National | 1,524,893 | 11,586 | 4,442 | 28,634 | 63,814 | 1,752,073 | 1,963,448 | —222,773 |
| Northwest | 22,095,797 | 7,170,110 | 52,589 | 4,189,975 | 270,274 | 35,986,047 | 35,048,585 | 220,741 |
| Pan American Combined | 318,588,126 | 24,201,585 | ..... | 47,017,722 [3] | 11,918,590 | 410,783,860 | 387,683,917 | 14,054,090 |
| Alaska | 4,399,891 | 204,062 | 2,217 | 495,581 | 54,126 | 5,228,023 | 6,180,894 | —881,651 |
| Atlantic | 150,002,292 | 10,714,032 | ..... | 15,811,575 | 4,038,315 | 186,366,934 | 169,774,000 | 16,909,568 |
| Latin America | 76,912,209 | 2,561,867 | ..... | 13,349,915 | 2,413,673 | 101,459,754 | 112,674,484 | —10,717,031 |
| Pacific | 87,273,734 | 10,721,624 | 12,240 | 11,490,854 | 5,412,476 | 117,872,265 | 99,056,845 | 19,052,961 |
| Panagra | 14,759,442 | 665,271 | ..... | 2,467,922 | 46,703 | 19,998,190 | 20,995,096 | 55,421 |
| Resort | ..... | ..... | ..... | ..... | 2,454,951 | 2,515,942 | 2,612,780 | —263,768 |
| Trans Caribbean [1] | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| Trans World | 77,587,920 | 7,959,866 | ..... | 5,709,894 | 4,391,978 | 100,958,035 | 83,861,584 | 16,386,384 |
| United | 21,695,013 | 811,579 | 45,654 | 432,918 | 47,990 | 23,265,893 | 17,202,021 | 5,592,698 |
| Western | 4,580,004 | 37,412 | ..... | 83,451 | ..... | 4,810,016 | 4,564,199 | 182,092 |
| **LOCAL SERVICE** | | | | | | | | |
| Allegheny [1] | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| Bonanza | 4,543,442 | 50,175 | 32,194 | 70,572 | 111,195 | 8,226,774 | 7,569,224 | 436,181 |
| Central | 2,406,260 | 82,882 | 29,888 | 92,914 | 47,140 | 5,984,580 | 5,676,164 | 297,634 |
| Frontier | 6,352,584 | 179,059 | 56,421 | 322,791 | 120,389 | 13,760,113 | 13,227,107 | 329,157 |
| Lake Central | 2,855,461 | 70,962 | 115,400 | ..... | 8,511 | 4,819,671 | 4,780,167 | 8,116 |
| Mohawk | 9,229,143 | 145,807 | 131,043 | 153,787 | 247,328 | 13,189,912 | 13,378,127 | —703,735 |
| North Central | 12,660,869 | 372,394 | 286,626 | 293,511 | 129,089 | 20,609,032 | 21,357,231 | —958,751 |
| Ozark | 7,609,285 | 167,473 | 172,903 | 246,329 | 74,690 | 12,305,139 | 12,319,626 | —159,644 |
| Pacific | 6,186,266 | 149,993 | 48,500 | 56,240 | 667,905 | 7,173,004 | 11,385,180 | —358,544 |
| Piedmont | 7,118,073 | 119,622 | 95,811 | 123,530 | 253,108 | 12,424,699 | 11,782,874 | 333,902 |
| Southern | 3,587,326 | 138,930 | 63,900 | 103,455 | 10,095 | 7,032,259 | 7,575,937 | —571,195 |
| Trans Texas | 5,038,907 | 179,689 | 75,829 | 204,728 | 120,800 | 9,140,648 | 8,620,799 | 602,603 |
| West Coast | 6,207,248 | 115,915 | 37,046 | 112,229 | 25,063 | 12,017,972 | 11,039,856 | 708,269 |
| **HAWAIIAN LINES** | | | | | | | | |
| Aloha | 4,664,833 | 25,861 | ..... | 82,011 | 46,993 | 4,979,072 | 5,208,000 | —445,117 |
| Hawaiian [1] | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| **CARGO LINES** | | | | | | | | |
| AAXICO | ..... | ..... | ..... | ..... | 5,349,849 | 6,054,619 | 5,251,192 | 1,196,278 |
| Aerovias Sud Americana | ..... | ..... | ..... | 1,214,758 | ..... | 2,868,798 | 2,816,477 | 9,965 |
| Flying Tiger | ..... | 206,888 | 210,698 | 12,733,646 | 12,756,061 | 26,407,117 | 27,533,591 | —1,777,412 |
| Riddle | ..... | 100,963 | 125,969 | 4,248,485 | 1,982,783 | 6,505,292 | 8,332,567 | —1,891,342 |
| Seaboard & Western | ..... | 4,200,974 | ..... | 6,733,296 | 5,395,903 | 16,647,988 | 21,182,437 | —4,899,440 |
| Slick | ..... | ..... | ..... | ..... | 11,799,050 | 12,000,214 | 10,885,544 | 926,481 |
| **HELICOPTER LINES** | | | | | | | | |
| Chicago Helicopter | 1,819,177 | 36,489 | ..... | 10,990 [3] | 2,380 | 3,438,409 | 3,387,756 | 63,319 |
| Los Angeles Airways | 228,812 | 151,763 | 171,986 | ..... | 2,168 | 1,682,442 | 1,440,079 | 257,544 |
| New York Airways | 1,039,732 | 56,713 | 38,540 | 40,828 | 41,802 | 3,480,676 | 3,553,528 | —108,962 |
| **ALASKA LINES** | | | | | | | | |
| Alaska Airlines | 2,531,680 | 701,054 | 14,898 | 619,874 | ..... | 9,013,355 | 8,360,592 | 751,640 |
| Alaska Coastal | 1,052,756 | 120,410 | ..... | 114,827 | 49,237 | 2,234,485 | 2,156,396 | 46,140 |
| Cordova | 183,026 | 107,468 | ..... | 124,223 | ..... | 1,247,841 | 1,220,326 | 6,630 |
| Ellis | 718,287 | 58,378 | ..... | 68,573 | 12,541 | 1,336,833 | 1,315,966 | —16,931 |
| Kodiak [1] | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |
| Northern Consolidated | 935,406 | 593,831 | ..... | 438,455 [3] | 158,837 | 3,027,352 | 3,010,745 | —109,422 |
| Pacific Northern | 7,221,319 | 906,700 | 33,164 | 1,153,700 | 39,479 | 11,597,433 | 10,960,579 | 497,500 |
| Reeve Aleutian | 1,687,014 | 496,824 | ..... | 432,180 | 205,232 | 2,908,348 | 2,434,016 | 429,979 |
| Western Alaska | 70,174 | 18,007 | ..... | 6,839 | 34,816 | 194,468 | 194,033 | —3,559 |
| Wein Alaska | 1,137,575 | 694,305 | ..... | 381,917 | 539,208 | 5,082,785 | 4,724,543 | 254,966 |
| Avalon | 271,493 | 7,454 | ..... | 8,114 [3] | 58,503 | 345,842 | 424,764 | —80,105 |
| Samoan [1] | ..... | ..... | ..... | ..... | ..... | ..... | ..... | ..... |

[1] Not available. [2] Operating profit or loss. [3] Property.

Compiled by AVIATION WEEK from airline reports to the Civil Aeronautics Board.

How advanced ideas grow into reality a



# at Grumman...

**Four capabilities qualify Grumman for advanced outer space projects:**

**FIRST: manpower**—Grumman's labor stability has made possible the organization of a group of scientists, engineers and skilled workmen with high individual and collective experience.

**SECOND: systems management ability**—Grumman has repeatedly demonstrated its ability to administer complete, complex systems, from initial design to final utilization.
Most recent examples are the AO-1 Mohawk, the WF-2 Tracer, the A2F Intruder, and the W2F Hawkeye, all operational within the last 30 months.

**THIRD: complete research and test facilities**—Grumman's already extensive aero-space facilities were further expanded in 1960 by a new 5-million-dollar Electronics Systems Center which houses some of the most advanced equipment in the country. A major space environmental installation is also currently under way.

**FOURTH: continuing space studies**—For many months Grumman scientists and engineers have carried on extensive studies in such fields as stabilization and control, data processing, plasma physics, magnetohydrodynamics, hypersonic aerodynamics and related fields, to complement the company's outer space programs.

These four areas comprise Grumman's competence in transforming ideas into reality. This ability is being demonstrated in the Orbiting Astronomical Observatory (OAO) shown at left in an artist's impression. Conceived by Goddard Space Flight Center of National Aeronautics and Space Administration, and now under development by Grumman, the OAO will be used to study the unknowns of ultraviolet radiation from the stars . . . the life history of stars . . . the origins of the universe. Launching date: 1963. Grumman Aircraft Engineering Corporation, Bethpage, Long Island, N. Y.

**Advanced ideas grow into reality at . . .**

Grumman

# AIRLINE OBSERVER

▶Trend of Kennedy Administration thinking appears to be running toward more centralization of U. S. transportation systems, with government control tightened through closer coordination between regulatory agencies. Formation of a transportation department at cabinet level has not yet emerged as a strong possibility. In the development of a national transportation policy, chances are good that the outcome of the Federal Aviation Agency task force studies, confined to national aviation goals, and the Commerce Department task force studies, devoted to over-all transportation policies, will conflict.

**▶Austrian Airlines and South African Airways are showing strong interest in Sud Aviation Caravelle turbojet transports. Manufacturer also is conducting extended talks on a Caravelle order with Air-India, but the carrier has not yet reached a firm decision. KLM is wavering between the Caravelle and Boeing 727. Sud officials also have discussed their transport with Trans World Airlines and American in the U. S.**

▶Federal Aviation Agency and Civil Aeronautics Board, concerned over increasing use of separate airports serving cities sufficiently close to be accommodated by one airport, will consider the joint airport concept as an important factor in the allocation of federal funds for airport improvement and in applications for scheduled airline service.

**▶Continental Airlines is retiring more than $6 million in 5¾% convertible subordinated debentures issued less than three years ago to finance its aircraft re-equipment program. Planned conversion of the debentures into common stock will permit the airline to broaden its equity base, retire $6 million in outstanding debts and eliminate debt interest costs of $350,000 a year. Original due date on the issues was June 1, 1973. Continental expects to retain an additional $3.1 million of 4¾% debentures scheduled for retirement in 1970.**

▶Attorney General Robert F. Kennedy has asked Congress to increase penalties for making false bomb reports. Kennedy has proposed maximum penalties of five years in prison and a $5,000 fine for conviction on a felony charge of creating a bomb hoax. He also wants a $1,000 fine and one year imprisonment for pranksters convicted of a misdemeanor charge. Kennedy reports that the Justice Department has received 1,500 false bomb reports since 1956, identified 279 perpetrators, prosecuted 74, won 32 convictions.

**▶British European Airways plans a 2,000 flying hour per year utilization of its three Armstrong Whitworth Argosy 650 cargo transports (AW May 1, p. 45), which is expected to produce an annual freight capacity of 16.2 million ton miles.**

▶Federal Aviation Agency traffic controllers, responding to the forced resignation of Francis M. McDermott who was executive director of the Air Traffic Control Assn. (AW Apr. 24, p. 41), are circulating petitions demanding the recall of ATCA's four elected officers. ATCA controllers also are urging that the association's constitution and bylaws be rewritten to give local chapters a direct voice in group affairs. McDermott, who announced his resignation Apr. 17, has been invited to address a May 15-16 meeting of First Region (northeast area) controllers in Boston, where the issue probably will be decided.

**▶Aeroflot has carried more than half a million passengers on its Moscow-Leningrad route since introducing 100-passenger, twin-jet Tu-104Bs in April 1959. The Tu-104Bs cover the 400 mi. over "the most popular air route in the USSR" in 55 min. Next summer, Tu-104Bs are to make up to 13 Moscow-Leningrad round trips on weekdays, with more scheduled on Saturdays, Sundays and holidays.**

▶British European Airways' proposal for its own terminal at London Airport would involve BEA operation of a short-haul terminal for all airlines at the field. Currently, more than 75% of all airline movements at London Airport involve BEA aircraft or aircraft of airlines handled by BEA on the ground.

# SHORTLINES

▶**Air Traffic Conference** has adopted new standards for qualifying airline travel agents. Agents will now post a $10,000 bond with the secretary of the conference, demonstrate certain experience in travel and airline sales, then be placed on the conference agency list after investigation, making them eligible for appointment by the airlines.

▶**ALA Austral**, an Argentine airline, will buy four Dutch Fokker F-27 aircraft to be delivered in March-April, 1962. The aircraft will be powered with Rolls-Royce Dart RDa. 6s.

▶**British Overseas Airways Corp.** has signed a contract with Standard Telephone and Cables, Ltd., English associate of International Telephone and Telegraph Corp. for an electronic reservation system to provide information to BOAC agents in the United Kingdom and Europe for 20 weeks in advance.

▶**Federal Aviation Agency** has ruled that airline pilots with less than 100 hr. in command of a type or aircraft will be held to 100 ft. ceiling and one-half-mile visibility higher than established standards. Previously, airlines imposed such restrictions although check pilots were allowed to certify that a pilot could operate at standard landing minimums before the 100 hr. of experience were acquired.

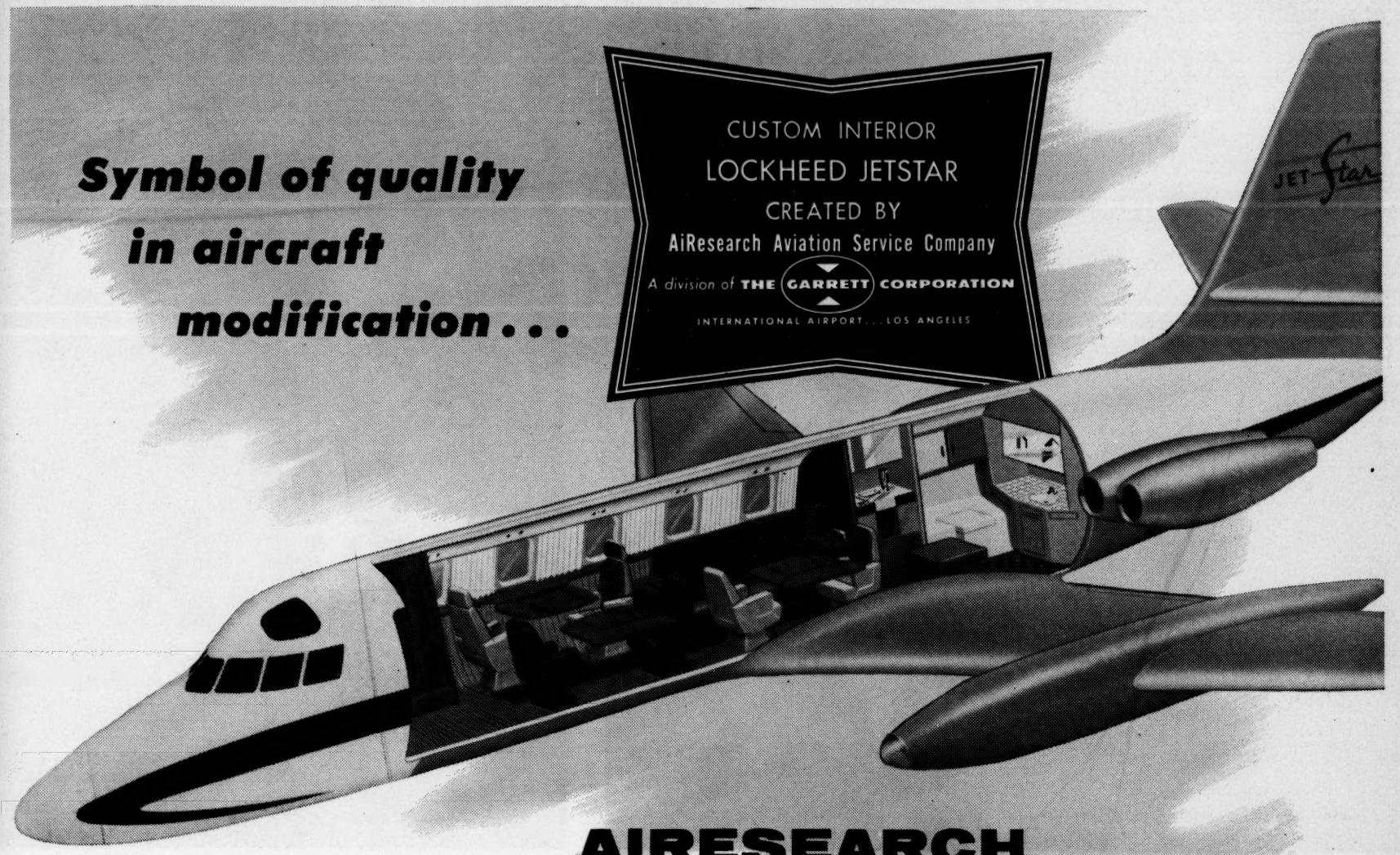
▶**Lake Central Airlines** has added Akron and Canton, Ohio to its system and inaugurated service between Indianapolis and Baltimore via Washington, D. C., Wheeling and Morgantown, W. Va., and Zanesville, Columbus, and Dayton, Ohio.

▶**Northwest Airlines** has sold its last seven DC-4s to Aircraft Holding Co., Seattle, Wash.

▶**Pan American World Airways** has reached a three-year agreement with Austrian Airlines to provide technical assistance to Austrian's management and operations departments. Austrian carrier serves 24 cities in 18 European and Middle Eastern nations.

▶**Piedmont Airlines** has an excursion plan allowing a 75% fare reduction on the return leg of a weekend round-trip flight. The return trip must be made the same weekend or on a weekend within 30 days.

▶**Seaboard & Western Airlines** changed its name last week to Seaboard World Airlines.




# AIRESEARCH JETSTAR CUSTOM INTERIORS

America's first pure jet corporate transport, the four-engined Lockheed JetStar, is an extremely high speed, pressurized aircraft. This advanced tool of modern management requires the utmost skill in the construction of furnishings and equipment and their attachment and fitting to the airframe. AiResearch Aviation Service provides this critically important skill through actual experience, having designed and installed more executive interiors for pressurized aircraft than any other company.

The JetStar is designed to accommodate a wide variety of highly efficient and comfortable interiors. Custom designed, fabricated and installed by AiResearch interior stylists and engineering specialists for the individual JetStar purchaser, all furniture, galleys, lavatories and other appointments are of fully-stressed, lightweight construction.

A full-scale mock-up of the cabin is used for prefitting the custom-built furnishings to insure precision work and reduce modification time. This modification includes exterior painting of the aircraft and ducting of the AiResearch pressurization system, standard equipment on all Lockheed JetStars.

The most complete modification center of its kind, AiResearch Aviation Service employs more than 600 highly trained and experienced engineers, technicians and craftsmen using the most modern manufacturing and testing equipment in the industry.

*Write, wire or telephone today for complete information regarding your custom interior for the Lockheed JetStar.*

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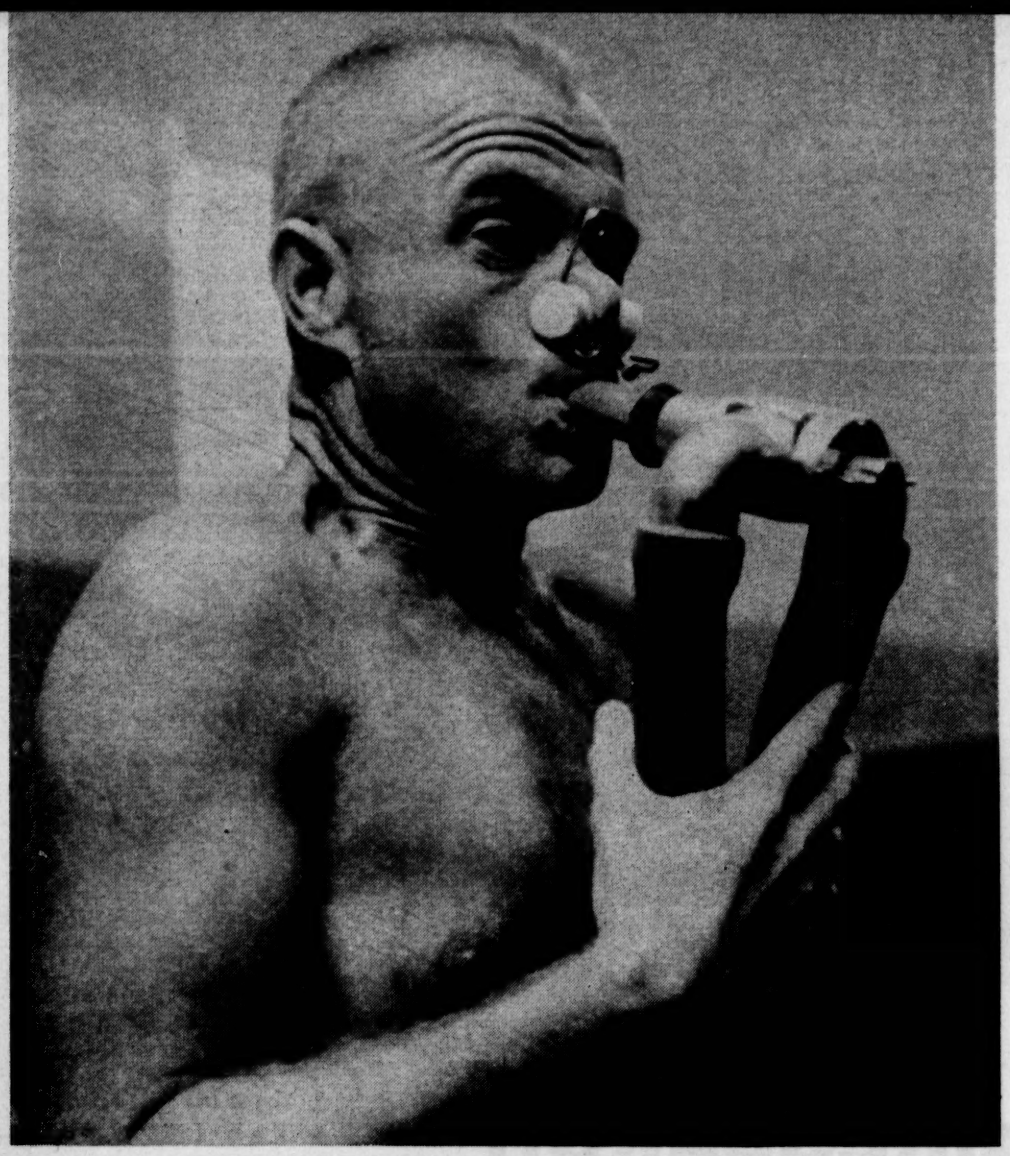

Marine Corps Lt. Col. John H. Glenn, Jr., one of the group of three Project Mercury astronauts selected by NASA for final pre-launch training, is shown at left undergoing respiratory testing and at right emerging from Hangar S at Cape Canaveral, Fla., in space suit.

# Mercury Astronauts in Final Pr

Navy Commander Alan B. Shepard dons space gear for a full count down and flight simulation test for astronaut and launch personnel programed to check out hardware and equipment. Shepard is helped into the Mercury capsule at right.

Astronaut John H. Glenn, Jr., is shown entering Mercury capsule already mated to Redstone booster to undergo a flight simulation test. At right, Glenn is seen inside the Mercury capsule checking the status of the capsule systems.

# al Preparations for First Manned Suborbital Space Flight

Commander Shepard, in space suit, enters elevator to ride up to third level of Redstone gantry and enter Mercury capsule.

## *from the reaches of space*

Unretouched time exposure shows Echo I communications satellite (long line) crossing heavens right to left. Shorter lines are stars "in motion."

## *to the depths of the sea*

Actual undersea photo of telephone cable off coast of Florida.

## *we use all of the arts of communication to serve you better*

One of our biggest capabilities is providing defense communications—wherever needed.

If we can't fill communications needs off the shelf, then we'll start fresh and create the answers to the problems. We've done that hundreds of times.

We recently handled the world's first telephone conversation *via satellite*. And we have started development of a world-wide communications system employing satellites.

We developed the world's first undersea telephone cables to speed calls between continents.

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Far in the frozen north, our engineers are putting together the communications system for BMEWS, the nation's Ballistic Missile Early Warning System.

For strategic defense installations, we provide a Group Alert and Dispatching System making it possible for one pull of the dial to ring up to 480 telephones *simultaneously*.

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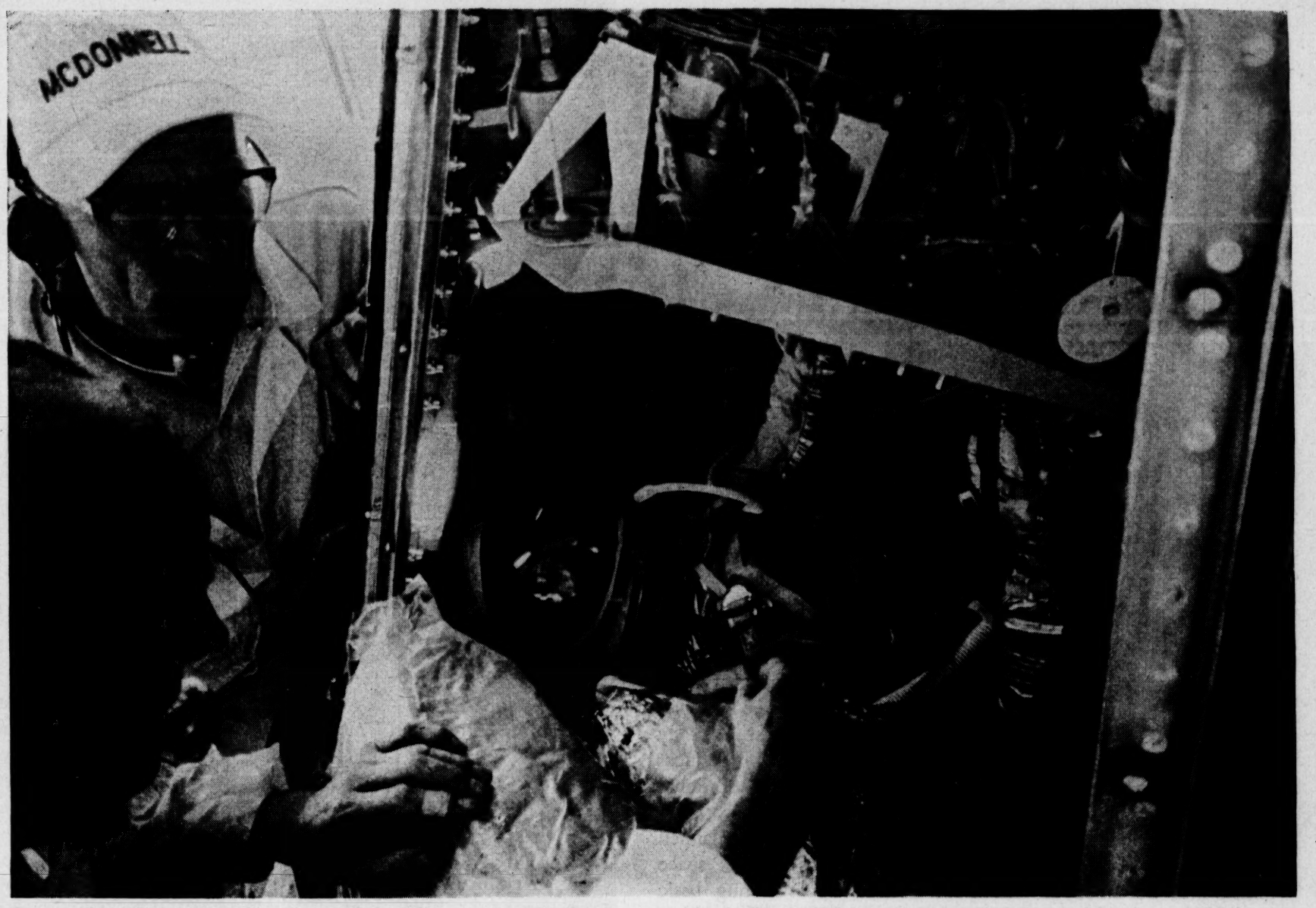
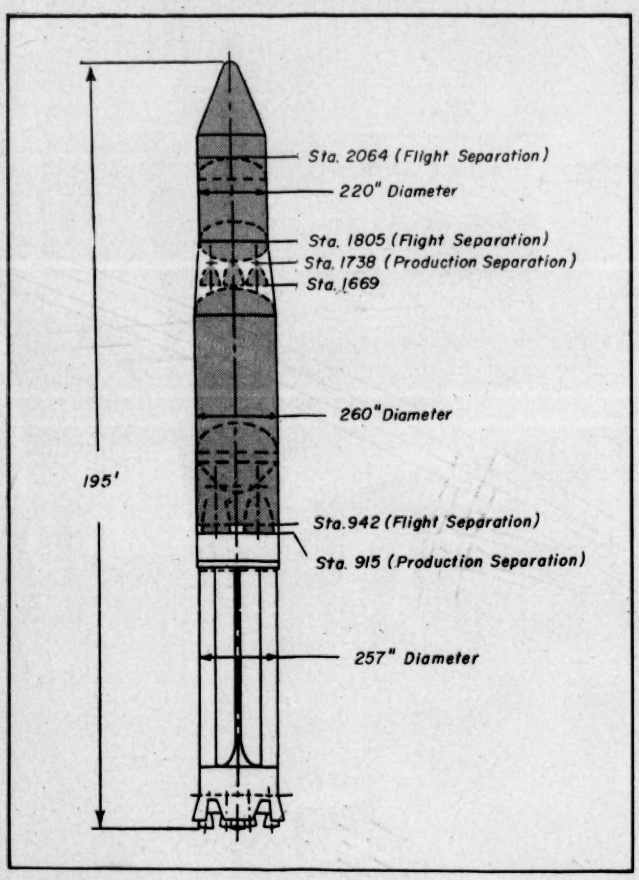
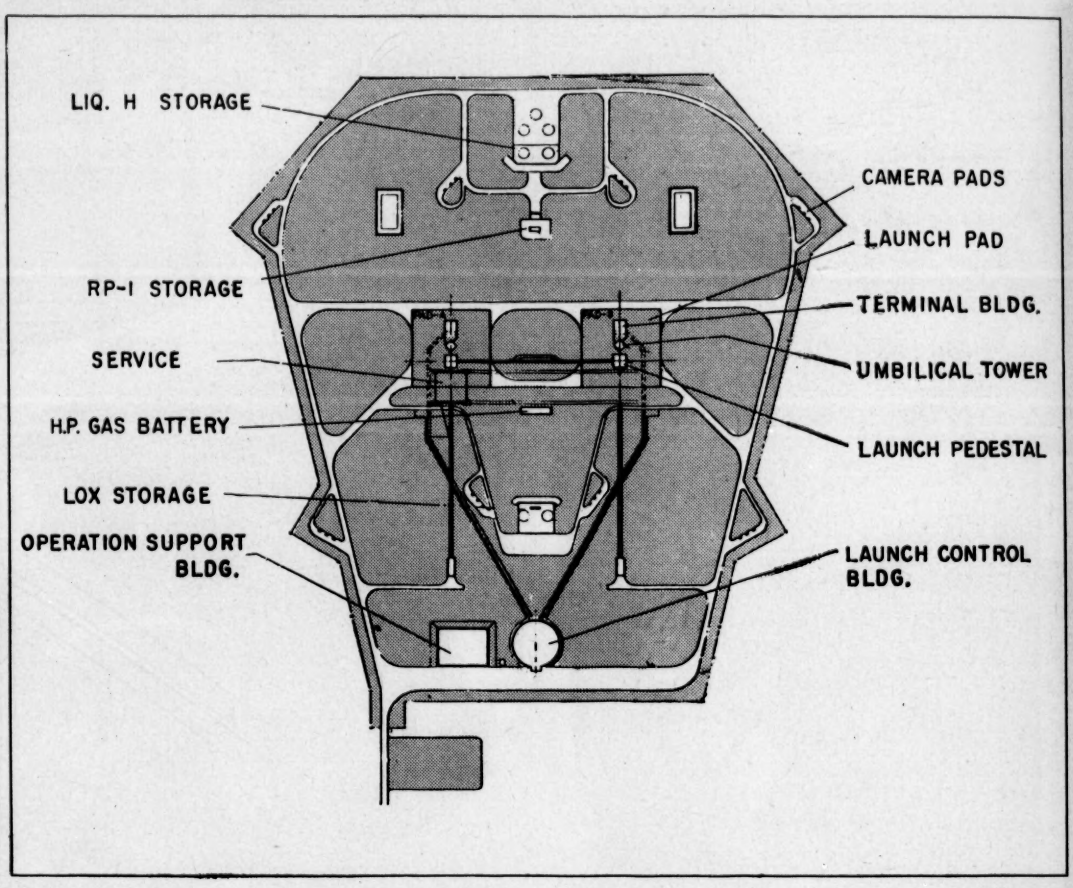



Commander Shepard is shown seated in Mercury capsule. First manned suborbital flight is programed to boost Mercury capsule to an altitude of 115 mi. and a distance of 290 stat. mi. in a 15-min. test of astronaut's ability to withstand the force of liftoff, powered flight, some 5 min. of weightlessness, and entry and landing phases (AW May 1, p. 30).

Air Force Capt. Virgil I. Grissom is prepared for testing in the U. S. Navy centrifuge at Johnsville, Pa. First manned Mercury flight was planned to give astronaut more chance to test manual operation of flight control system than cosmonaut Gagarin apparently had.




**SATURN C-2,** first space vehicle planned for NASA's Marshall Space Flight Center's projected facilities off Florida coast, basically will be a three-stage configuration developing a total of almost 3-million lb. thrust from stages S-I, S-II and S-IV. An additional stage, S-V, may be incorporated for use with some missions. Concept for new semi-offshore or offshore complexes (right) planned by NASA for Saturn C-2 and follow-on versions of this space vehicle will be based on maximum utilization of existing basic design of ground support equipment and pad layout for vehicle launch facility VLF-37 shown here in planform as it will be constructed on northern part of Cape Canaveral, about 3,800 ft. from the largely completed Launch Complex 34, which will handle initial Saturn C booster firings. VLF-37's design will accommodate thrust levels of 2-million lb., vehicle diameters up to 260 in., and vehicle lengths of 265 ft. with possibility of extension to 315 ft. New facility for C-2 vehicle will require that twin pads be separated by 1,200 ft. instead of 800 ft. as in VLF-37. Water depth at the off-shore complex will measure approximately 50 ft.

# NASA Plans Offshore Saturn C-2 Firings

**By Irving Stone**

**Los Angeles**—Huge launch facilities off the Florida coast to accommodate advanced versions of the Saturn space vehicle are being planned by NASA's Marshall Space Flight Center in anticipation of saturation conditions at the Atlantic Missile Range's Cape Canaveral launch site.

Proposals for a preliminary design study now are being evaluated in the industry competition being conducted by NASA. Contract award is expected late this month to one of the companies or industry teams which have proposed concepts.

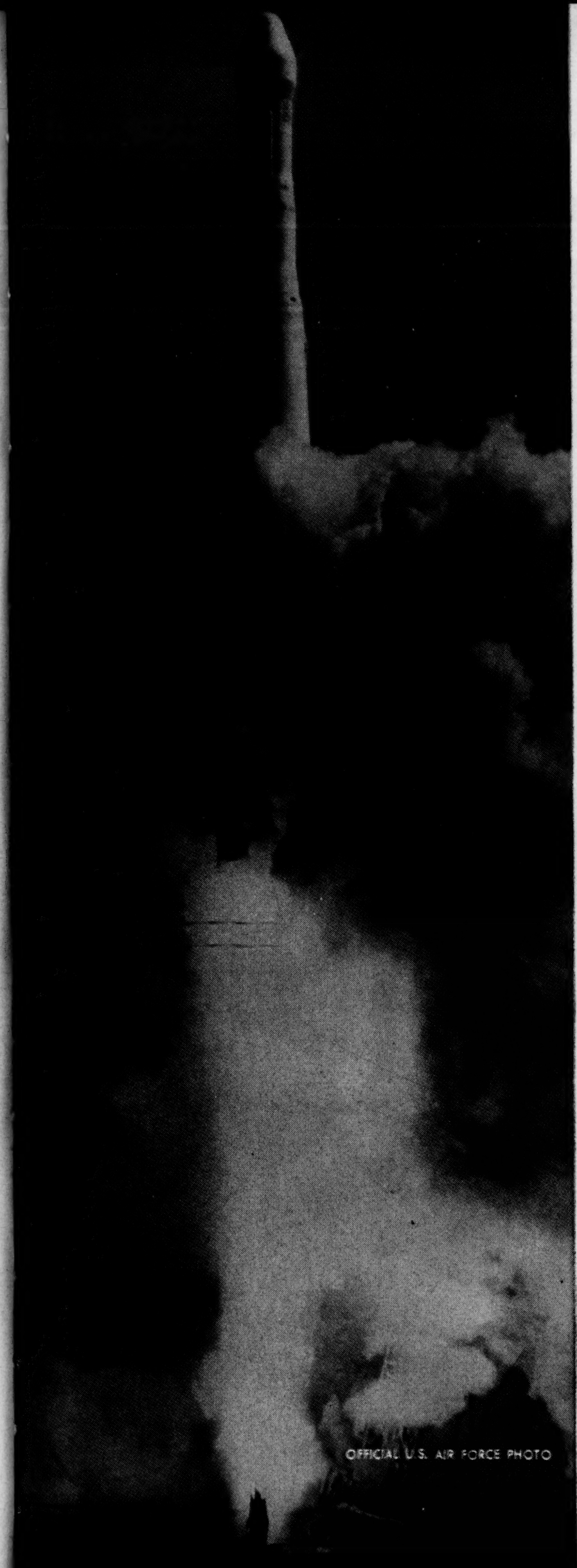
The study, considering both semi-offshore and offshore facilities, will be based on these fundamental assumptions:

- **Saturn C-2** will be the initial space vehicle to be launched from the new complex. This basic three-stage Saturn version would have an over-all length of 195 ft., a total thrust of almost 2.4 million lb. (See accompanying illustration.)
- **Nuclear propulsion** will be available by 1967 and could be used for either earth-launched or orbit-launched vehicles using hydrogen as fuel. This indicates that Saturn follow-on vehicle versions to be launched from the complex will incorporate nuclear stages, probably the Nerva nuclear space propulsion system to be developed under NASA's Project Rover.
- **Semi-offshore facilities** would be located in the general area of existing (Launch Complex 34) and planned Saturn facilities (Vehicle Launch Complex 37) at Cape Canaveral.
- **Offshore complex** would be located at such a distance from the shore that primary logistical support will be by water-borne vessels.
- **Water depth** at the offshore complex location will be approximately 50 ft.
- **Use of hydrogen fuel** will require that separation of launch pads and separation of pads from service structures will be about 1,200 ft. Blockhouse-pad maximum separation distance will be 1,200 ft., for allowable voltage drop for present cabin and checkout-equipment design.
- **All structures** will have to withstand maximum winds of 125 mph.
- **All space vehicles** will have to be oriented on a due east azimuth at launch.

While the present focal point for all Saturn space vehicle operations is the launching facilities at Cape Canaveral, Marshall Space Flight Center's projection for expansion of these facilities is based on the premise that launch requirements for large space vehicles may soon exceed the land limits of the Cape. But in the new facilities planned to cope with this situation, aim is to realize maximum utilization of existing basic design of ground support equipment and launch facilities such as embodied in the VLF-37 Saturn C-1 duplex pad layout projected for Cape Canaveral. Modification for adaption to the semi-offshore or offshore concepts is expected to be held to a minimum, consistent with new requirements.

## Semi-Offshore Complex

The semi-offshore facility will have a portion of the launch complex on the mainland (Cape Canaveral) and another portion located over water or on an artificial extension of the mainland. This approach offers the specific advantages of limited extension of land area capabilities with maximum use of existing ground support equipment and facility designs. Marshall Space Flight Center feels that the feasibility of adapting these existing designs to a semi-

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| 2N393 | High speed switch | MIL-S-19500/77A (Sig C) |
| 2N495 | Medium frequency amplifier (Silicon) | MIL-T-19500/54A (Sig C) |
| 2N496 | Medium speed switch (Silicon) | MIL-S-19500/85 (Sig C) |
| 2N499 | VHF amplifier | MIL-S-19500/72A (Sig C) |
| 2N501A | Very high speed switch | MIL-T-19500/62 (Sig C) |
| 2N502A | VHF amplifier | MIL-S-19500/112 (Sig C) |
| 2N599 | Medium speed switch | MIL-S-19500/166 (Navy) |
| 2N1118 | Medium frequency amplifier (Silicon) | MIL-S-19500/138 (Sig C) |
| 2N1119 | Medium speed switch (Silicon) | MIL-S-19500/139 (Sig C) |
| 2N1158A | VHF oscillator | MIL-S-19500/113 (Sig C) |
| 2N1199A | High speed switch | MIL-S-19500/131 (Sig C) |
| 2N1200 | HF amplifier (Silicon) | MIL-S-19500/105 (Sig C) |
| 2N1201 | HF amplifier (Silicon) | MIL-S-19500/101 (Sig C) |
| 2N1411 | High speed switch | MIL-S-19500/133 (Sig C) |
| 2N1499A | High speed switch | MIL-S-19500/170 (Sig C) |
| 2N1500 | Very high speed switch | MIL-S-19500/125 (Sig C) |

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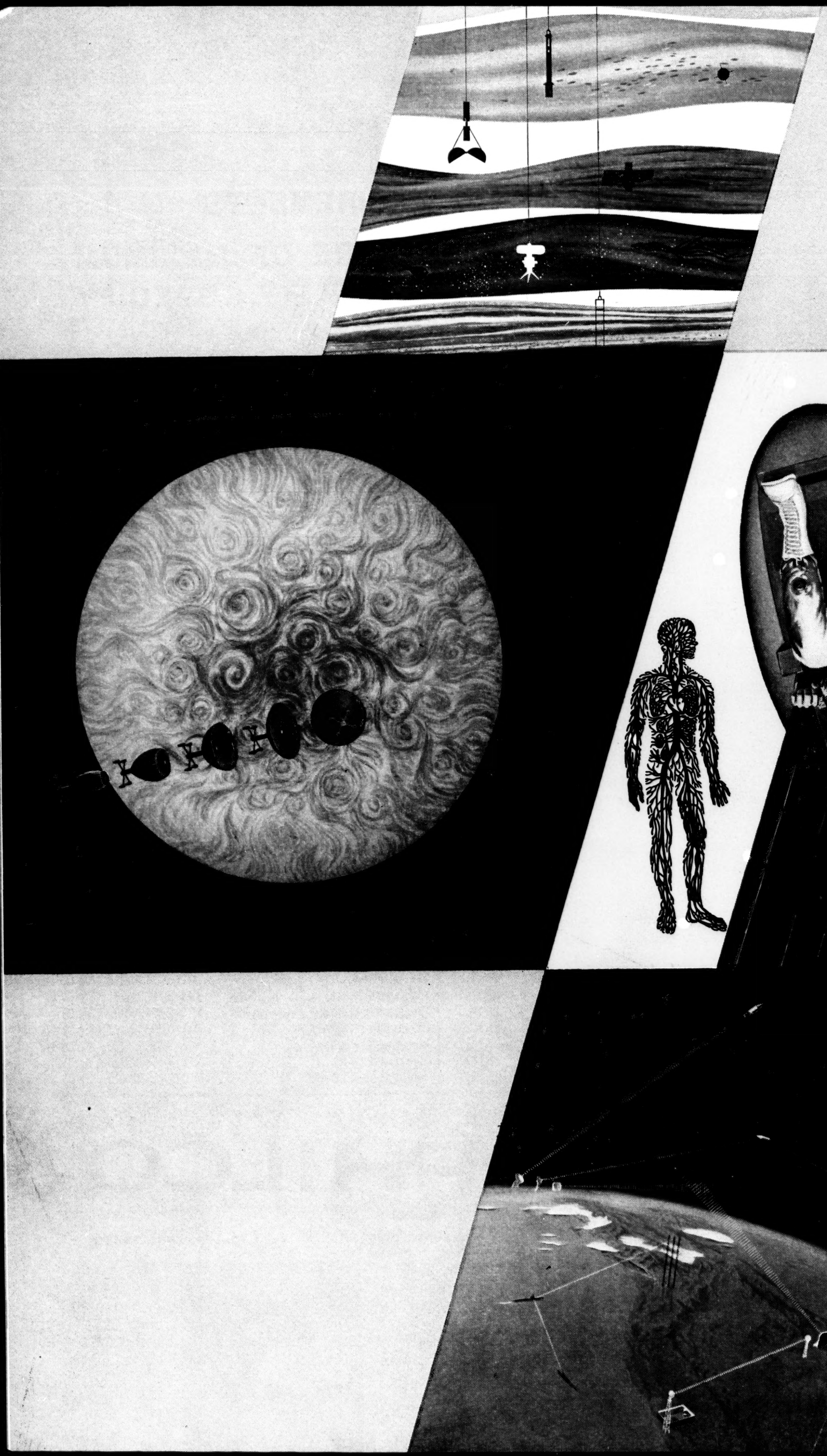
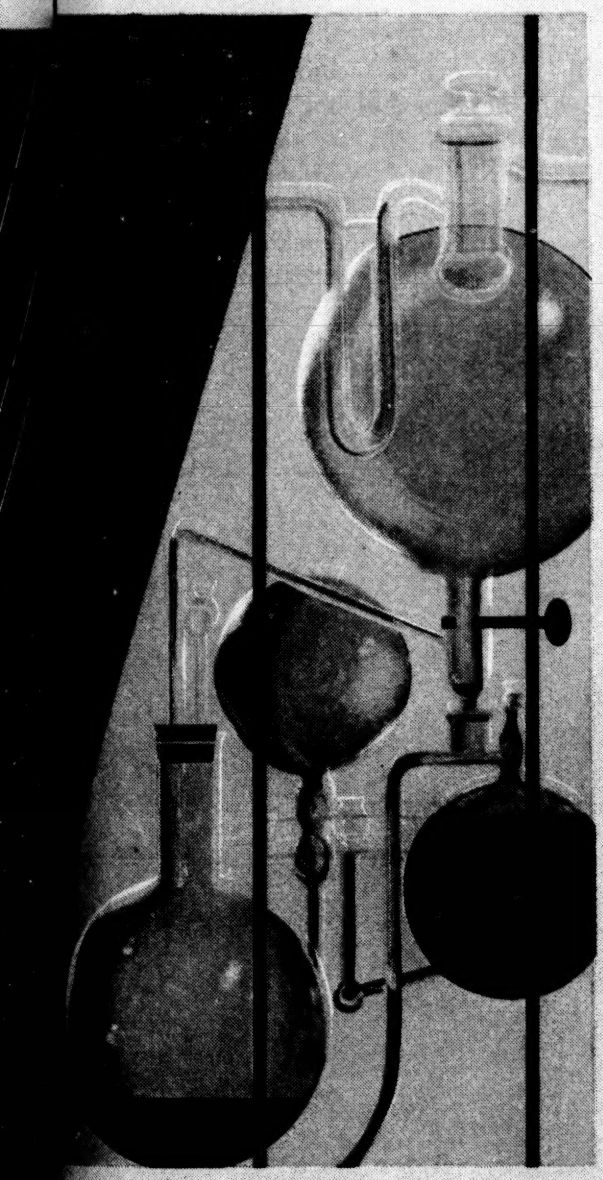


RESEARCH AND DEVELOPMENT AT LOCKHEED



## *...is setting the pace in space for years ahead*

Lockheed Missiles and Space Division's progress transcends even that of an era marked by phenomenal scientific growth. To an important degree, the Division's research and development activities are considered to be the basis of its success.

As systems manager for the Navy POLARIS Missile and the Air Force AGENA Satellite in the DISCOVERER and MIDAS programs, the Division is engaged in extensive research in many diverse engineering and scientific fields. Some highlights of current research and development activities include: Operations research and preliminary design; nuclear and space physics; physical electronics; chemistry; materials; mathematics; engineering mechanics; electronic communications and instrumentation; and computer research and development.

Research is a concept which holds many different meanings to those concerned with science and technology. At Lockheed, a distinction is made between the *nature* of the work and its *objectives*. Consequently, such terms as basic research, applied research, systems or operations analysis, engineering and development are used. A given individual might find that his personal inclination often leads him quite naturally from one type of research to another. Recognition of this desire is reflected in the scope of work conducted in the Research Branch at Lockheed Missiles and Space Division. Principal research activities are: Pure and applied research; advanced design; engineering analysis; electronic prototype development; and machine computation.

Organization is determined by the *technical field* rather than by the *type of research*. For example, a structural dynamicist, as a member of the Structures Department, may, on one occasion, work on future space vehicle configurations, at another time be associated with current projects such as the POLARIS or Satellite programs, or he may be engaged in basic research at the research laboratory. In each case, the individual has the opportunity to maintain as much or as little contact as he wishes with others in his field of interest.

Important staff positions at Lockheed's Research and Development Branch in Palo Alto are available. Those scientists and engineers with experience related to the above areas are invited to write to: Research and Development Staff, Dept. M-25C, 962 West El Camino Real, Sunnyvale, California. U.S. citizenship or existing Department of Defense industrial security clearance is required. All qualified applicants will receive consideration for employment without regard to race, creed, color or national origin.

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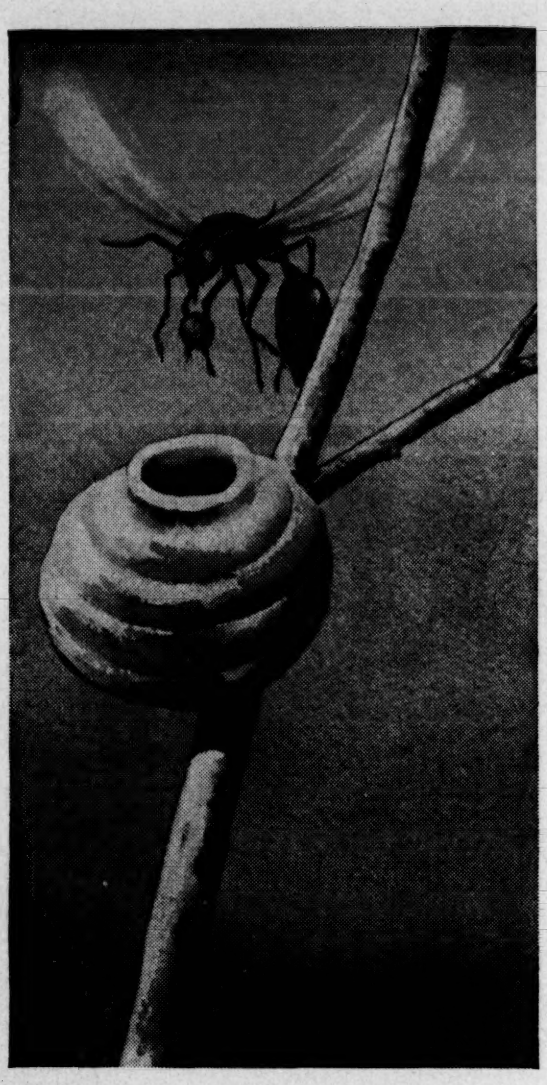

# *Engineered Environment*

**The thimble-sized nest of the potter wasp is a feat of engineered environment as well as artistry. The mother wasp carefully gathers hundreds of particles of wet clay and positions them inside the nest so that air can circulate around them. This maintains proper humidity for larvae during the hot, dry months.**

**How is humidity control being handled in *your* project? Proper and reliable functioning of electronic components as well as the efficiency of personnel depend on precision humidity control. Specialized AAF equipment that "tailors" the atmosphere for you includes many other engineered products built to rigid military standards.**

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## Physical Parameters of Saturn C-2 Stages

| Parameter/Stage | S-I | S-II | S-IV |
|---|---|---|---|
| Engine | 8-Rocketdyne H-1 (JP-4-lox) | 4-Rocketdyne J-2 (Liq. H-lox) | 6-P&W LR-115s (Liq. H-lox) |
| Thrust (lb.) | 8 X 188,000 | 4 X 200,000 | 6 X 15,000 |
| Diameter (in.) | 257 | 260 | 220* |
| Length (ft.) | 76 | 69 | 33* |
| Dry Weight (lb.) | 88,500 | 26,500 | ...* |
| Usable Propellants (lb.) | 600,000 | 300,000 | ...* |
| Liftoff Weight (lb.) | 709,500 | 361,300 | ...* |

* Original projection for Saturn C-2 included an S-IV third stage composed of four P&W LR-119s, each developing 17,500 lb. thrust, but change was made to the six earlier-development, lower-thrust (15,000 lb.) LR-115s. This is not expected to affect the overall configuration of the stage, hence the 220-in. dia. and 33-ft. length should remain essentially the same. Dry weight of the four-engine S-IV stage was to be 11,000 lb., stage weight at liftoff, 115,200 lb. (both figures include 2,500 lb. of guidance and control equipment not shipped with the stage.) Hence these weights for the six-unit S-IV stage will increase proportionately, as will the weight for the usable propellants, which was targeted to be 100,000 lb. for the four-engine S-IV stage.

For some missions, Saturn C-2 additionally may use an S-V stage, making it a four-stage vehicle. The S-V stage will consist of two LR-115 engines (instead of two LR-119s, as originally planned) each developing 15,000 lb. thrust, for a total S-V thrust of 30,000 lb.

Operational date for the Saturn C-2 space vehicle may be late in 1964. Development tempo will depend, in substantial degree, upon progress with Saturn C-1 vehicle.

offshore application, as contemplated, has been demonstrated in various industrial and defense applications and in many conceptual proposals for missile and space vehicle system.

In the development of the semi-offshore facility, many variations will be possible. Concepts may vary between placing the minimum or maximum facilities beyond the existing shoreline, the shoreline could be extended by artificial land buildup, causeways could be constructed, or channels dredged to accommodate water-borne vessels for operational and logistic support to the semi-offshore facilities.

The shallow water depth in the immediate offshore (semi-offshore) area will be a major factor in deciding whether the semi-offshore or the offshore concept is the optimum one.

### Offshore Possibilities

Offshore launching sites offer the advantages of unlimited area at no cost, remote location of launch facilities for special hazard protection, unlimited water supply for flooding jet blast deflectors, and other economic and operational advantages.

Preliminary investigations indicate favorable oceanographic and hydrographic conditions for establishing these launch facilities in the vicinity of Cape Canaveral.

All feasible schemes, such as fixed structures and semi-fixed floating vessels and dry docks will be evaluated in determining a sound approach to the development of the optimum offshore concept. Free-floating structures will not be considered in this particular study.

The service structure, umbilical tower, checkout and control equipment, and launch pad superstructure of the VLF-37 complex probably could be adapted to the offshore applications with only minor modifications. But extensive modification redesign of the launch platform, deflector (if one is used),

## Bidders for Saturn Offshore Facility Study

Industry members or teams which submitted proposals in competition for Saturn offshore launch facilities study include:

- Aerojet-General's Aetron Division, in association with Parsons, Brinkerhoff, Quade & Douglas.
- Kaiser Engineers Division of Henry J. Kaiser Co.
- Cal-Val Research & Development Corp., with Marine Division of Perini Corp., and Rader & Associates.
- Consolidated Western Steel Division of U. S. Steel Corp.
- De Long Corp. with Aeronutronic Division of Ford Motor Co.
- Douglas Aircraft Co., with Brown & Root, Inc.
- The Ralph M. Parsons Co., with Radio Corp. of America, and J. Ray McDermott & Co., Inc.
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**DEFENSE PRODUCTS DIVISION**

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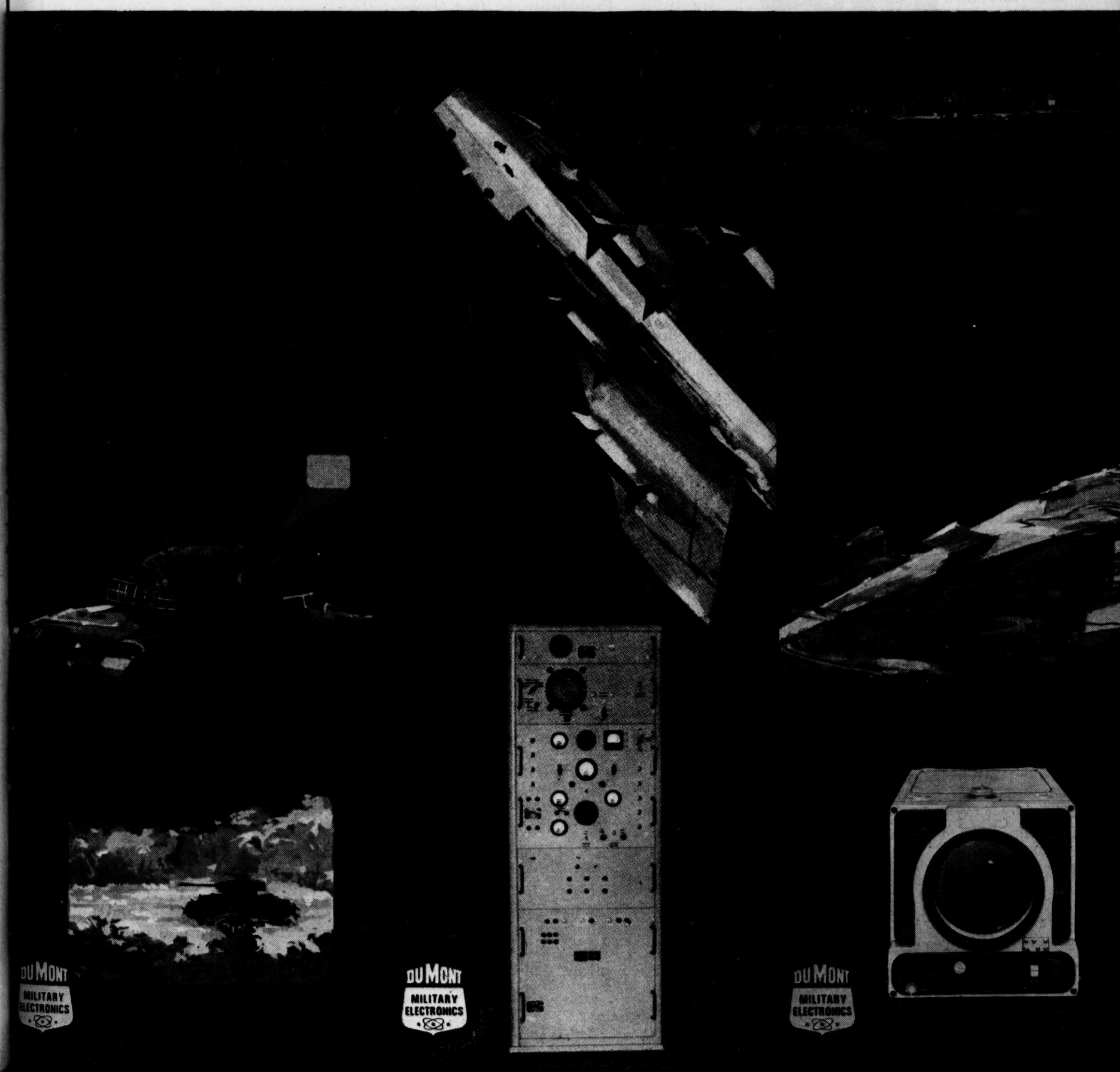
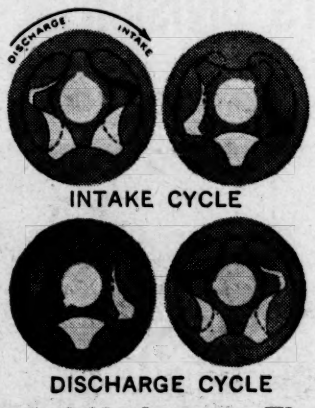


PUMP PRIMERS

ARTHUR A. NICHOLS

## HIGH EFFICIENCY PUMPING AT HIGH ALTITUDES

► Engineers concerned with the pumping of various aviation fluids know well the difficulties of getting good performance at high altitudes where low inlet pressures are encountered. Pumps which work well at low altitudes frequently run into trouble when they encounter the rapid pressure changes, shock and turbulence which promote foaming and lowered efficiency at high altitudes.




► **Gerotor pumps are efficient at high altitudes and therefore are frequently specified for this service. A specialized form of internal gear pump, the Gerotor has an inner toothed element and meshing outer toothed element. The inner Gerotor has one less tooth than the outer and the missing tooth space forms a chamber for transporting the fluid from the inlet to the outlet port.**

► Slow opening of the chamber as it traverses the large inlet and discharge ports results in avoidance of the sudden shock, rapid pressure change and turbulence which, in other types of pumps, results in foaming and lowered efficiency. Thus, Gerotor pumps offer exceptionally good performance at high altitude.

► **Low relative speed and closely held clearances between the two Gerotor elements mean high mechanical efficiency is maintained.**

► Low weight, high performance and unusual adaptability to space and geometry of housing structure make Gerotor pumps ideal for gearbox lube and scavenge service.

► **Engineers concerned with drives, auxiliary power sources, gear boxes and various transmission design problems involving pressure lubrication have found Gerotor type pumps extremely useful in their attempts to hold weight down and achieve maximum compactness with high service reliability.**

► Applications for Gerotor aircraft pumps lie in the range of pressures up to 1000 psi. They are suitable for low pressure hydraulic and servo systems, hydraulic motors, lube, scavenge and booster service, electronic coolant pumping in aircraft and guided missiles, and similar applications.

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blockhouse structure, electrical distribution system, and propellant system will be necessary, depending upon the basic concept under consideration.

On a marine project, such as the offshore facility, the construction time spent at sea will be the most expensive and the most hazardous. This will promote emphasis, in the study, on design for maximum prefabrication and to facilitate marine erection of the structural elements to meet a preplanned sequence and method of construction. Comparative time and cost factors will have to be evaluated for on-site construction and floating entire prefabricated structures to the offshore position.

Methods of transporting and transferring propellants will be investigated, particularly with regard to cryogenics, since the quantities of liquid hydrogen and oxygen will be substantial for stages S-II and S-IV—considerably more than 300,000 lb. and 100,000 lb., respectively. Probability is that barge-mounted tanks will be the most feasible method of transporting these low-temperature fluids, but other methods, such as towing flexible containers for conventional RP-1 fuel, may also be applicable.

Initial transfer of all propellants from a transport vessel to the space vehicle tanks may have to be accomplished with the vessels moored adjacent to the launch pad, but because evaporation losses of liquid hydrogen and oxygen require replenishing during standby until just prior to launch, a remote replenishing station and transfer lines will be required for this operation.

Integral electrical power supply, including emergency standby power, may be required as part of the offshore complex. Analysis will involve a comparison of central plant location versus transport-mounted power supply for the propellant transfer operations, and an above-water distribution system versus an under-water system.

Handling and erection of the booster and upper stages at sea is not expected to present new problems, except in the method to be used for transfer from a floating vessel to the launch pad. A floating vessel transporting the vehicle would have to be stabilized prior to transfer operations to minimize the possibility of damage to the stage, since transfer may be required under rough sea conditions.

Safety requirements for the offshore site will be similar, but more complex, than for a land-based site. An escape system to meet a prelaunch operational disaster will have to provide for waterborne escape from the launch pad area as well as escape from the service structure and launch pad. If an explosion or launch pad abort should dump large quantities of burning propellants on the water surface, means will be required to prevent the fire from spreading to other structures or nearby vessels.

Because launch preparations will require several days, quarters will be required for semi-permanent operations crew, a permanent maintenance crew, and for a limited number of transients. These quarters might be aboard ship, or aboard the offshore structures.

The logistic plan for the offshore structure will favor a minimum amount of shipping in keeping with effective support of launch complex operations. Probability is that all logistical support items will be available at Port Canaveral. Key factors in the logistic plan will be the employment of multi-purpose vessels, sequence of launch operations, and method of handling the space vehicle stages and propellants.

The formulation of the semi-offshore and offshore facilities concepts will be developed and compared in detail on the basis of economics, operational and schedule requirements, simplicity, reliability, construction scheduling, support requirements, and safety.

Consideration will be given to the potential expansion capabilities of each concept, in relation to how they would be affected by multiple complex requirements, and the special requirements that would result from larger space vehicles and the employment of nuclear powerplants.

Also the comparison of the two approaches will be a major factor in the determination of which concept or combination of concepts will be optimum. One possibility is that the studies may determine that the semi-offshore facility may be the first step in the progression to an offshore facility.

## Refueling Satellite

**Liquid air cycle engine concept under study as a powerplant for USAF's proposed Aerospace Plane also "has tremendous potential" for a satellite that would serve as a refueling station for other spacecraft, a National Aeronautics and Space Administration official said recently.**

**Elliott Mitchell, NASA's assistant director for propulsion, told an American Rocket Society meeting in Palm Beach, Fla., that a satellite orbiting in the upper reaches of the atmosphere could collect air and liquefy it for use as an oxidant or as the working fluid for an electrical engine.**

**"The satellite could then act as a refueling station for a low-thrust spacecraft that would rendezvous, refuel, and continue on into space," Mitchell said. He cautioned that this "involves such neat tricks" as reducing the size of a liquid oxygen plant from thousands of tons to satellite size, "so that it is not something that will be here tomorrow."**

# FROM
# VANGUARD TO DYNA SOAR

## *Honeywell's experience in guidance and control systems spans the space age*

The space age is only three years old, but the companies responsible for the spectacular advances during this short period qualified for their space assignments by virtue of extensive prior experience and knowledge. Honeywell, for example, had been designing and producing automatic flight control systems for over fifteen years when it was selected to develop the inertial reference system for Vanguard I. A number of Honeywell flight control systems were "firsts"—electronic (for the B-17), supersonic (for the F-100) and adaptive (for the X-15).

Honeywell inertial reference systems or precision floated gyros have guided 30 of the 39 satellites the U.S. successfully placed in orbit. Vital contributions have been made to space exploration, space communications, meteorology, missiles, and manned space flight. Honeywell's role has been extended to systems responsibility on some of the most sophisticated space projects. In every case, Honeywell's contribution has been backed by the full scope of scientific skills and production facilities required to do the job. Illustrated on the pages below are examples of Honeywell's proven capability . . . from Vanguard to Dyna Soar.

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**Senior Flight Systems Engineer** with experience in systems design, stability and control, and configuration analysis for aircraft and/or missiles. Should be familiar with the techniques associated with satellite rendezvous, trajectory and re-entry analysis.

**Senior Optical Pick-off Engineer.** Experimental physicist with experience in development of small precise electro-optical devices.

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**Systems Integration Specialist.** Broad background in aerodynamics, thermodynamics, structures, guidance and control, configuration and design trade-offs.

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# Zero-Gravity Flights Test Liquid Hydrogen

Convair-Astronautics is studying the behavior of liquid hydrogen, the fuel for the Centaur space vehicle, under zero-gravity conditions in a series of 35 KC-135 flights scheduled to be completed in June.

Convair engineers are conducting the study to determine the effects of weightlessness on the motions of liquid hydrogen, bubble formation, the venting of surplus vapor and rates of heat transfer. The company is developing the Centaur stage, which is powered by two Pratt & Whitney LR-115 liquid hydrogen engines, for NASA .

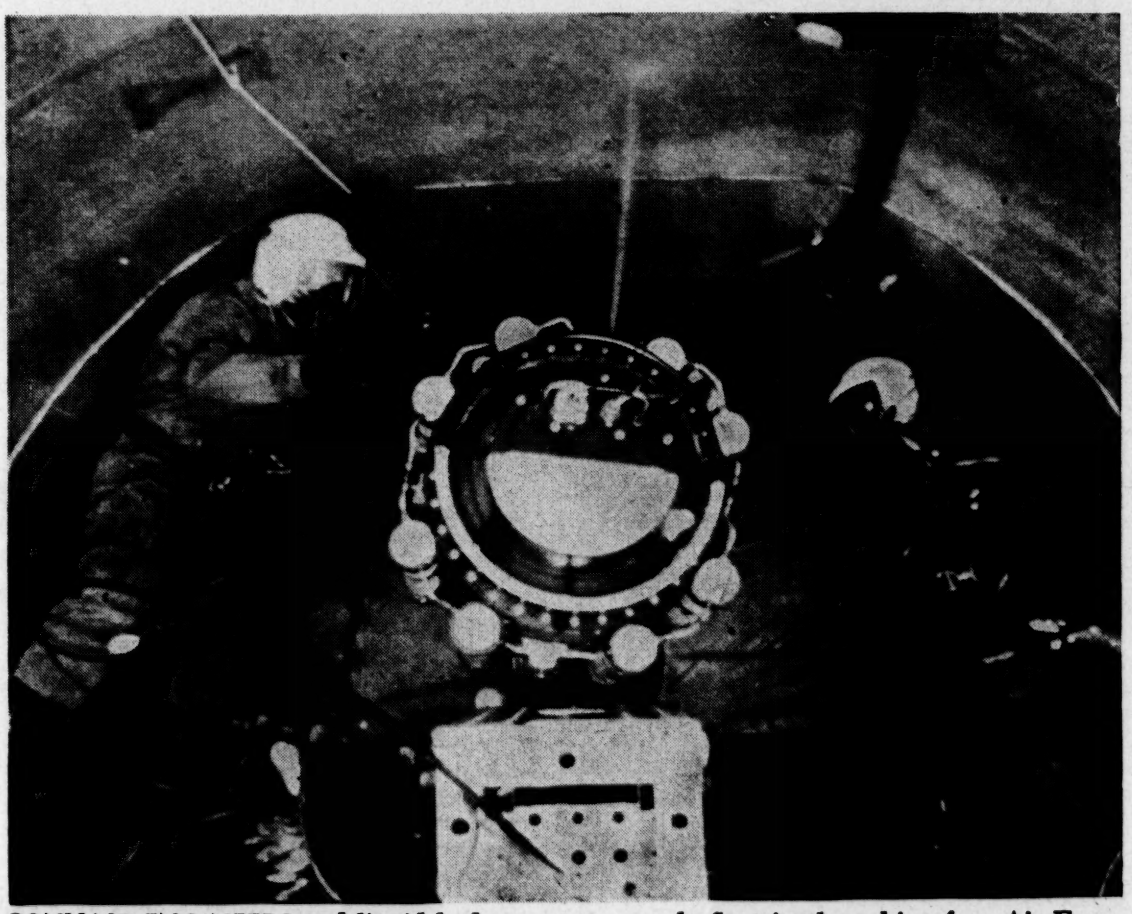
About 15 tests are conducted during each two-hour flight, with test runs providing up to 30 sec. of weightlessness. The KC-135 studies are a continuation of experiments begun with a C-131B, which provided 5-12 sec. of weightlessness. Over 500 tests have been run.

Convair conducts its experiments in a KC-135. USAF Aeronautical Systems Division operates from Wright-Patterson AFB, Ohio, for zero-gravity tests.

Observations are made with a capsule 4 ft. long and 2 ft. wide which carries a 5 qt. vacuum bottle containing the liquid hydrogen. The capsule is placed inside a nylon bag 20 ft. long and 10 ft. wide which is inflated with nitrogen to avoid the explosive hazard of spilled hydrogen. The capsule has high pressure nitrogen cylinders attached to its sides, and this inert gas drives a self-contained power system to operate instruments measuring temperature, pressure and heat transfer rates, plus a recorder and 16 mm. camera.

Two Convair engineers, wearing oxygen masks, work in the nylon bag during the experiments. They replenish nitrogen and hydrogen supplies between test runs. Another two engineers make observations through windows in the bag. The KC-135 pilot monitors the tests with a closed-circuit television system and extends their duration by maneuvering the aircraft to keep the fuselage from touching the capsule.

**LIQUID HYDROGEN** is contained in a 5 qt. vacuum bottle inside this 4-ft.-long capsule during Convair studies of the behavior of this space vehicle rocket engine fuel under zero-gravity conditions. Tests are conducted with an Air Force KC-135, which provides up to 30 sec. of weightlessness. Capsule is placed in a 10 ft. x 20 ft. nylon bag inflated with nitrogen to avoid explosion hazards. Small cylinders attached to the capsule contain high pressure nitrogen to run a power system to operate instruments and recording systems.



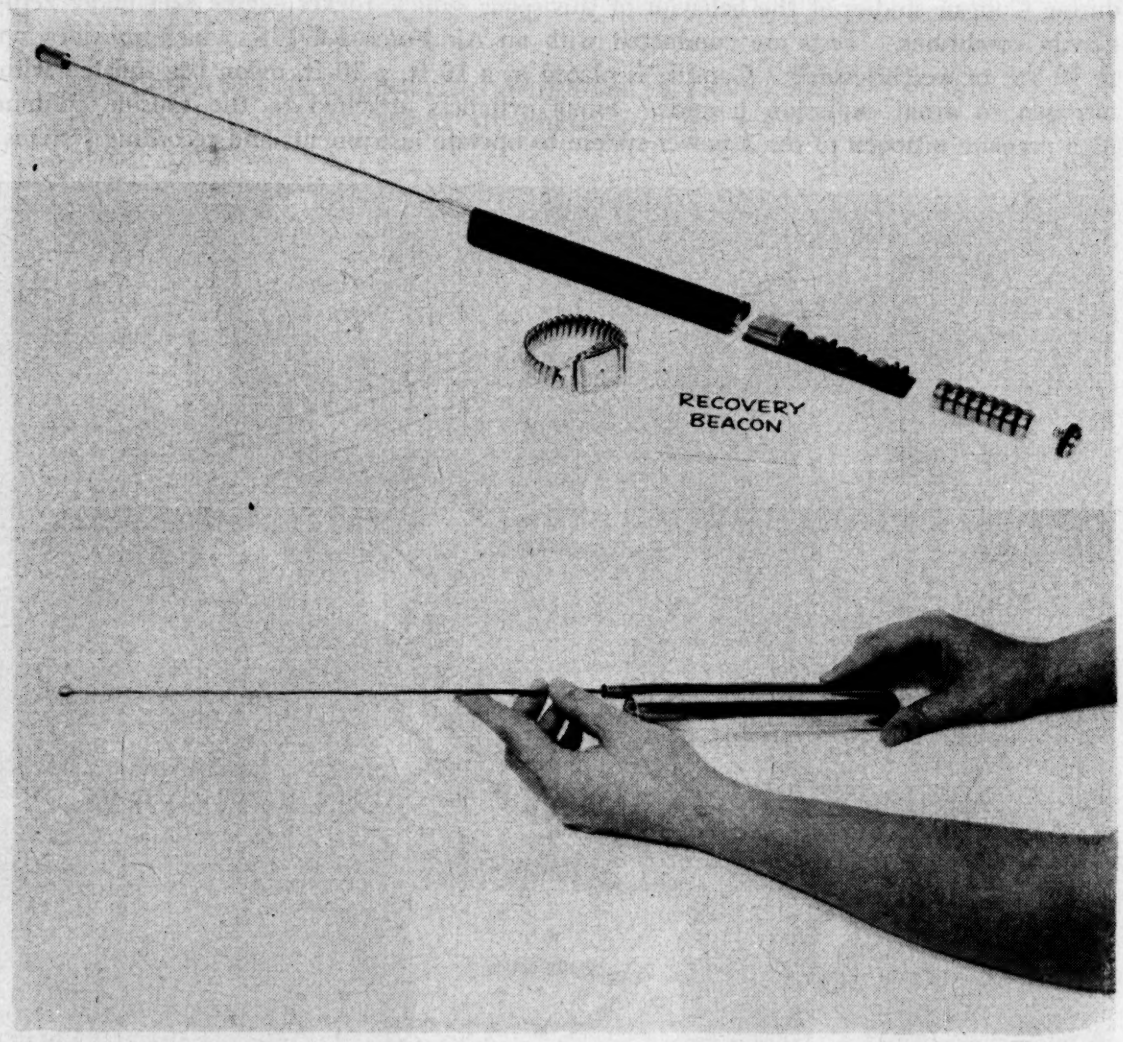
**CONVAIR ENGINEERS** and liquid hydrogen test capsule float in the cabin of an Air Force KC-135 during studies of the rocket engine fuel under weightless conditions. Pilot monitors the test with a closed-circuit television system and maneuvers the aircraft to keep the fuselage from touching the capsule, extending the duration of the test run.

## Russians Hint At Weather Satellite

**Moscow**—Development of a Russian weather satellite system—similar to the National Aeronautics and Space Administration's Nimbus—has been hinted by Prof. Georgi Pokrovskii, Soviet scientist, who said in a Tass interview that it would be "expedient to create within the next few years a system of man-made satellites which would form several rings, at different altitudes, over the earth's surface."

**DOUGLAS** Aircraft Co. pilot in water during tests of company's distress beacon which is attached to his waist. Signals generated by tiny transmitter beacon are radiated from antenna in floating bag which is automatically inflated by carbon dioxide discharge.

# Lightweight Pilot Distress Beacons Tested




**PROTOTYPE** of Distressed Airman Recovery Beacon (DARB) which will be able to be carried in the pocket of a pilot's flight suit. Beacon will radiate UHF distress signals for 100 hours after collapsible antenna is withdrawn from case. Final package will weigh 5½ oz. and its low-power signals will be capable of being picked up by special airborne phase-lock receivers on line-of-sight distances up to 150 mi.

By Barry Miller

**Los Angeles**—Two different concepts of equipping a pilot with a lightweight, relatively long-life distress beacon which can be attached to or placed inside a pocket of his flight suit have been tested separately in recent experiments conducted by their respective developers. Each beacon can generate distress-frequency signals on which rescue planes can home directly without flying special search patterns.

The beacons are small and light enough to be carried on the pilot's suit without encumbering him. Should he be injured or otherwise unable to move about, the automatically operated beacons can generate distress signals needed to bring rescue planes directly to him.

One of the systems is called DARB (Distressed Airman Recovery Beacon) and was developed by Hallamore Electronics Co., a division of the Siegler Corp. in Anaheim, Calif. It employs a technique borrowed from earth satellite tracking technology which enables it to operate over relatively long distances with little power. This reduces the amount of batteries and with it the weight of the beacon. It requires that search aircraft carry phase-lock tracking receivers to pick up the weak signals at the longer line-of-sight ranges.

The other approach, which can be

used with standard commercial or military receivers fitted with an adapter and two quarter wavelength antennas, is being evolved at Douglas Aircraft Co., Santa Monica, Calif. This system, too, is designed to pick up very low level distress signals over line-of-sight ranges of about 150 mi.

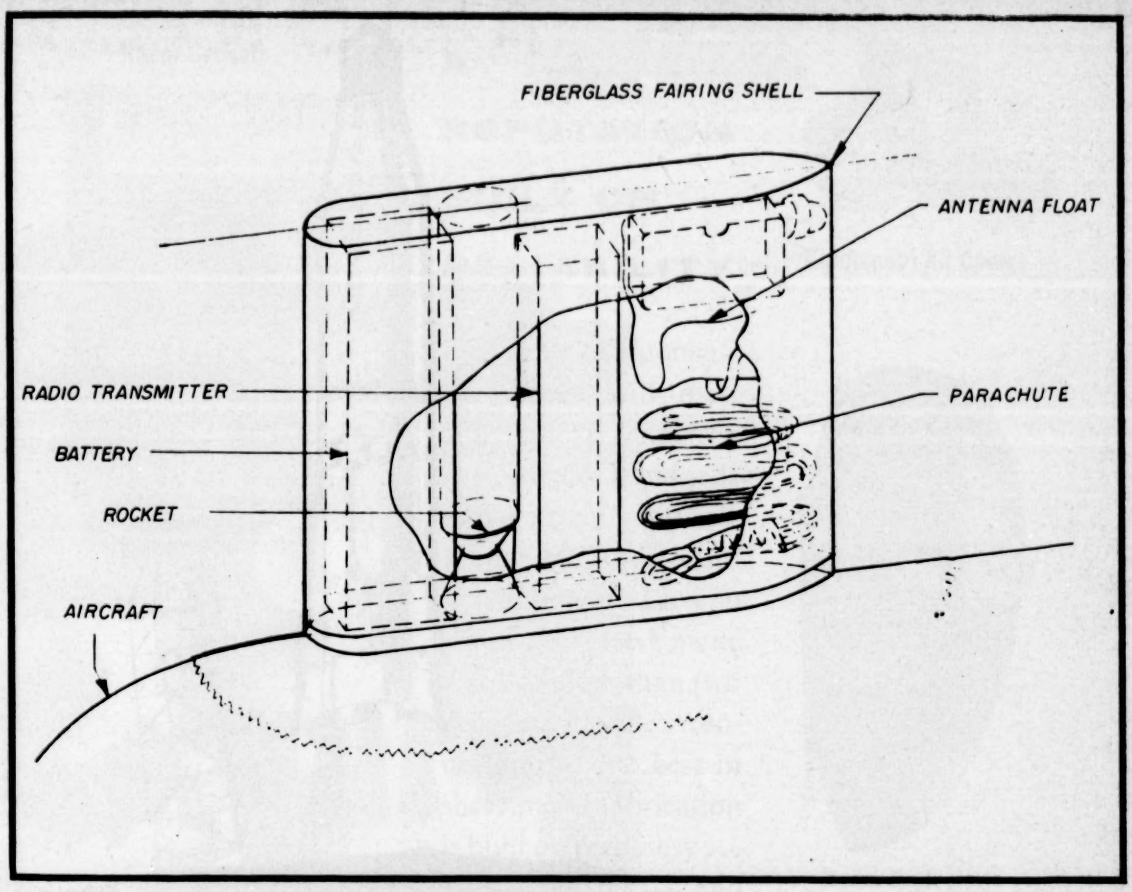
In bringing their distress beacon concepts to the hardware stage, each company has gone through several successively smaller and lighter beacon models. In its final packaged form, Hallamore's DARB beacon, complete with mercury batteries and capable of putting out slightly more than one milliwatt of power, would scale 5½ oz., the company says. This beacon would generate continuous wave distress signals on the military distress frequency of 243 mc. in the UHF range. These signals could be picked up by airborne phase-lock receivers on a line-of-sight at least 100 mi. away.

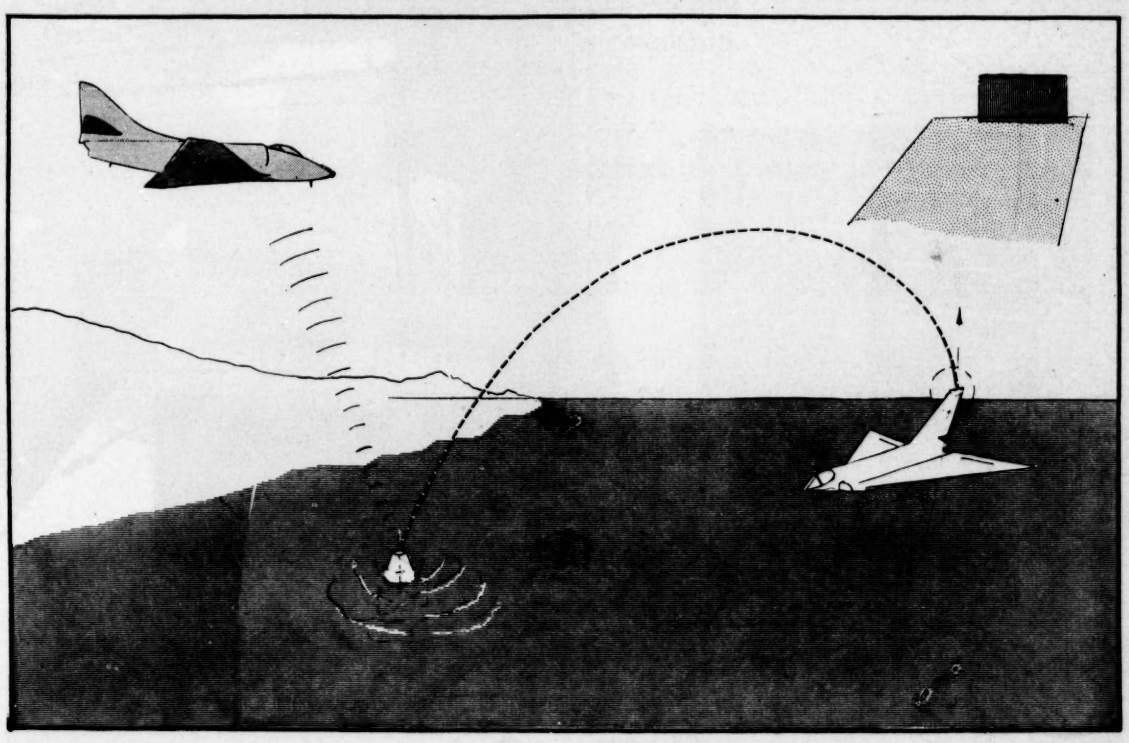
One of the Douglas beacons, made in cooperation with General Antronics Corp., Culver City, weighs less than one pound, has power output of 125 milliwatts and generates UHF distress signals for 8 hr. A slightly larger unit, also made for Douglas by General Antronics, weighs 1.8 lb., operates for 10 hr. and turns out distress signals in both VHF (121.5 mc.) and UHF (243 mc.) bands. In this beacon the basic oscillator output is doubled to the VHF frequency; doubled again by a varactor diode to the UHF frequency. Both companies are aiming these beacons at the military market.

## Hallamore System

Hallamore's system employs airborne receivers similar to the Microlock type of tracking gear which has been employed in satellite and space probe tracking. In a test conducted by the company, the beacon was flown and the receiver operated at the Hallamore plant. The receiving system consisted of one of the company's narrow-band phase-lock receivers incorporating a standard Nems-Clark receiver as an RF amplifier and converter. In narrow band operation, this receiver system has a minimum signal sensitivity of about −140 dbm., accounting for the low power output requirements of Hallamore's DARB beacon.

The beacon in this test consisted of a battery-powered transistor power oscillator synchronized to a crystal source. The power stage was a Philco MADT 2N1158 transistor oscillator loosely coupled into the antenna circuit. In this case radiated output power was 2.5 mw. In one packaging scheme the beacon was fitted within an aluminum case with a collapsible quarter wavelength antenna mounted to it. The pilot can extend the antenna; automatically turning the beacon on.



**DISTRESS beacon package can be mounted on tip of vertical stabilizer of aircraft as indicated above. Douglas is developing package which would be fired by small rocket upon aircraft impact, would be parachuted to the ground or into the water nearby, and would then radiate distress signals. Drawing below indicates how floating beacon fired from vertical stabilizer of downed aircraft would radiate UHF distress signals.**

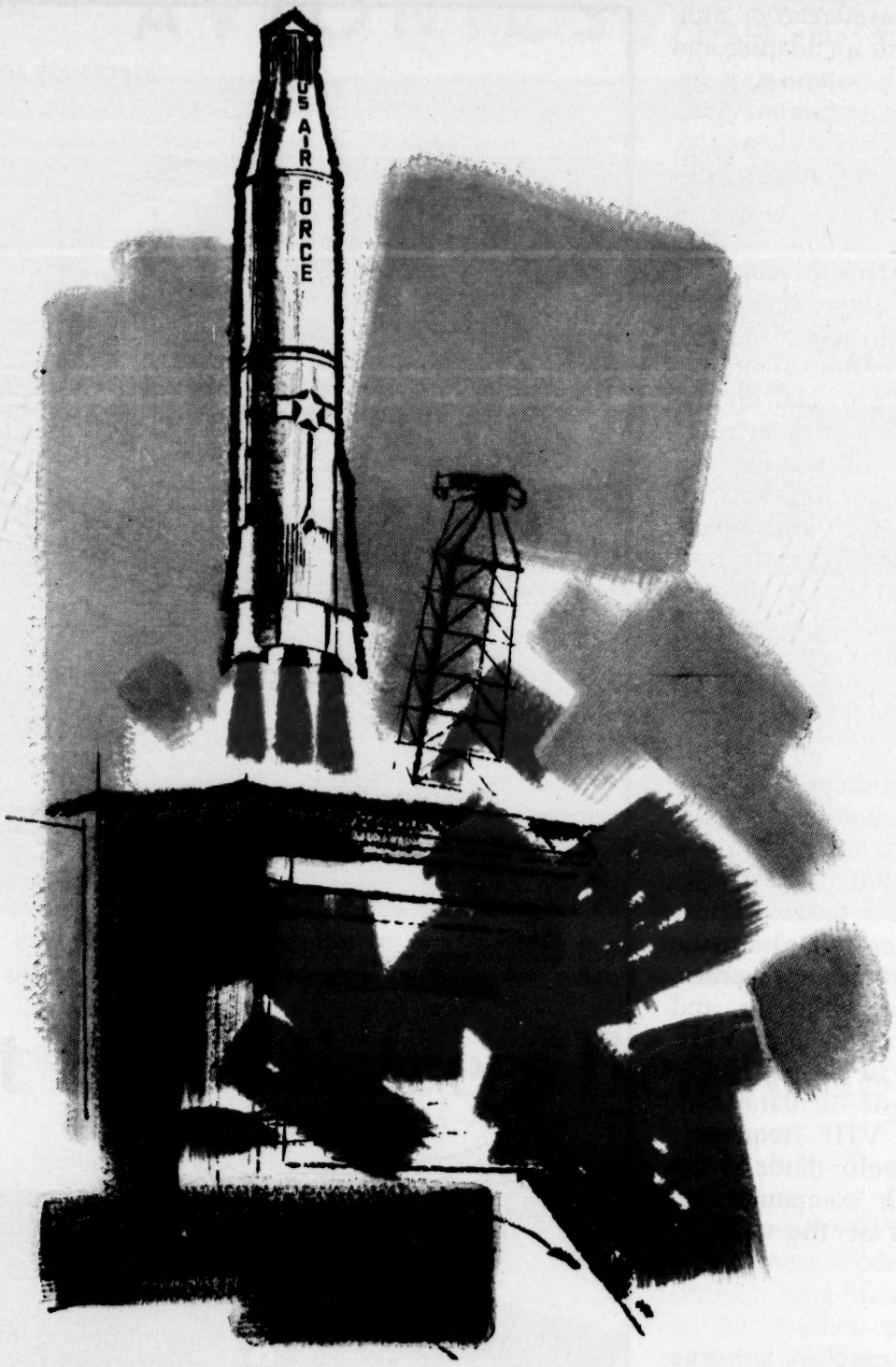
Hallamore has engineered a solid-state airborne phase-lock receiver to be used in conjunction with the beacon. It is fixed tuned, employs plug-in printed circuit cards. A broadband phase-lock detector occupies a card space of 2½ in. square The single channel receiver occupies a volume of 5 in. x 5½ in. x 15 in. and weighs less than 10 lb., according to Hallamore. Power required is roughly 1 watt at 28 v.

For one test, the phase-lock receiver and a standard telemetry receiver were flown side by side and both receivers attempted to pick up beacon signals. In many instances, the company relates, it was impossible to tell with the standard receiver whether the beacon was radiating.

In Douglas' approach, the lightweight beacon would be attached to the pilot's waist and connected by a waterproof cable to an inflatable balloon type of bag containing an antenna.

Thus, the antenna would be afloat and erect should the pilot land in the water. The beacon would begin broadcasting 600 and 1,600 cps. tones twice a second after the pilot pulls his parachute cord.

The pilot's precise location can be pinpointed, Douglas says, with the aid of a 5-lb. transistorized antenna adapter switch connected to a conventional

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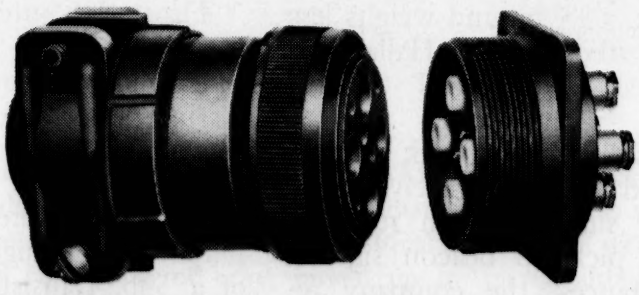

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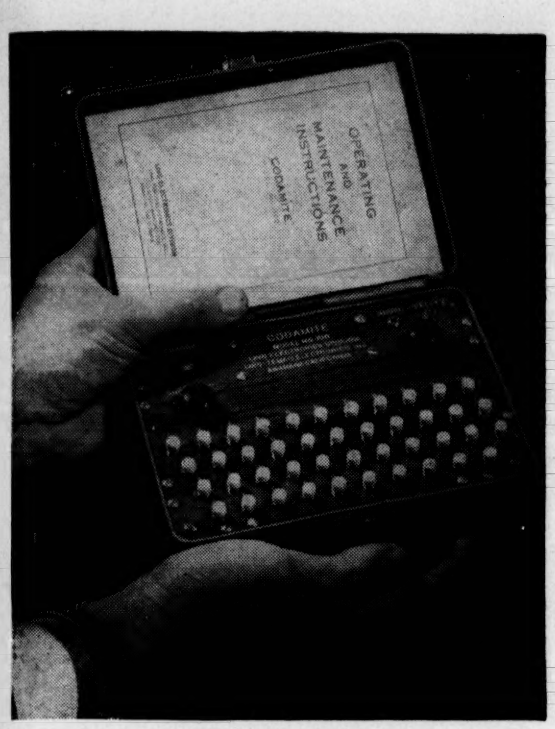


## Morse Code Generator

Push-button Morse code generator, MG-100 Codamite, produces perfect Morse characters which are transmitted at selectable speeds of 6 to 42 words per minute. Keyboard contains 43 characters including numbers and punctuation. Device weighs 4 lb. and uses solid-state circuitry throughout. Codamite also can be used to provide binary coded decimal output. Unit price is $1,275. Manufacturer: Ling Electronics Div., 1515 South Manchester, Anaheim, Calif.

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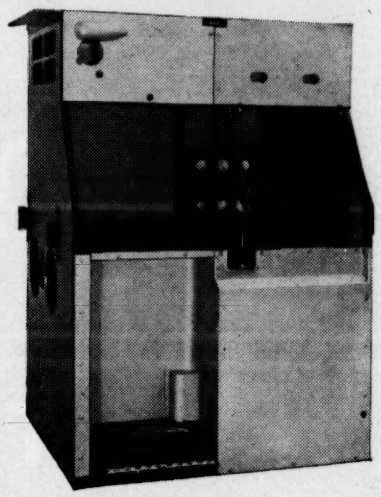
UHF receiver in the search plane. Two quarter wave whip antennas extending in opposite directions from the plane pick up the beacon signals whose relative strength is compared by the adapter. The adapter feeds impulses to a left-right meter mounted on the pilot's instrument panel. The meter is at zero when the antennas are at right angles to the beacon; will dip sharply as the pilot passes over the beacon, thereby indicating the location of the distressed pilot.

Douglas engineers estimate that an ARC-27 airborne military receiver equipped with the antenna adapter could receive signals from its beacon at distances up to 100 or 120 mi. An armed services receiver with an ARA-25 military adapter might pick up the signals out to 25 mi.

Tests of the Douglas system were conducted by the company over the Mojave Desert and over the water. For operation in mountainous areas, where a distressed pilot might be situated in a gully, the search plane can be equipped with a high-gain Yagi boom antenna to boost the range of signal reception. Pilots have been recovered 8 min. after takeoff of the rescue plane 35 mi. away, according to Douglas.

Douglas is trying to interest the services in an essentially similar system, utilizing the same beacon attached to the side of a life raft. The beacon

Radar Console



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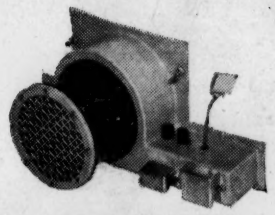

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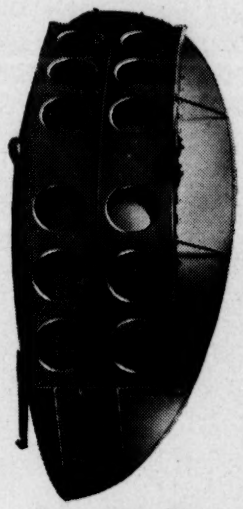
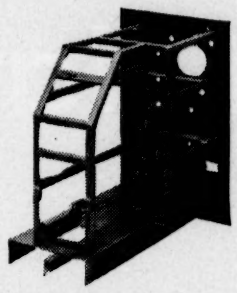
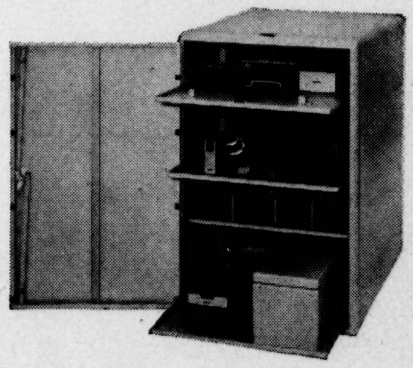


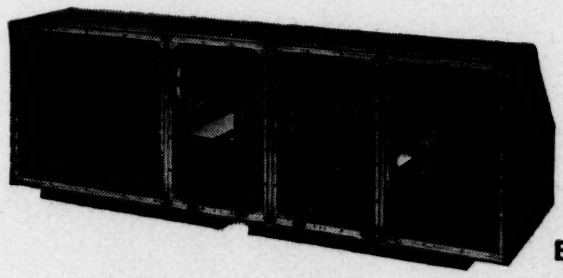
Radar Reflector



Electronic Frame

Storage Cabinet





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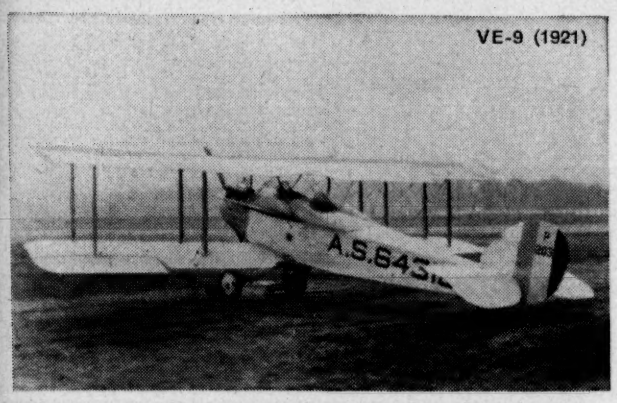
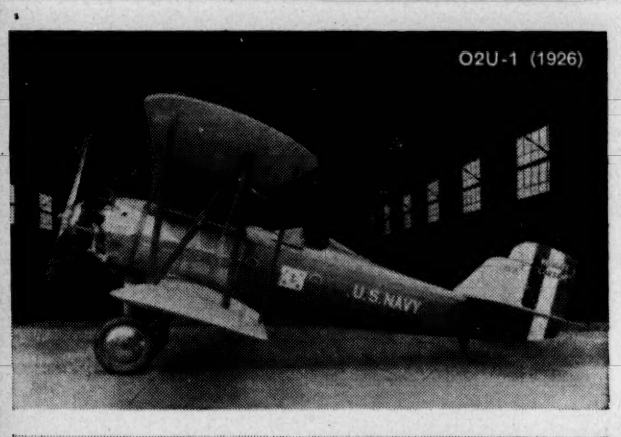
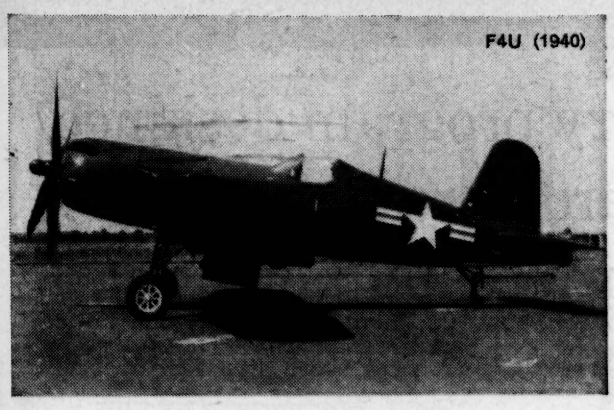
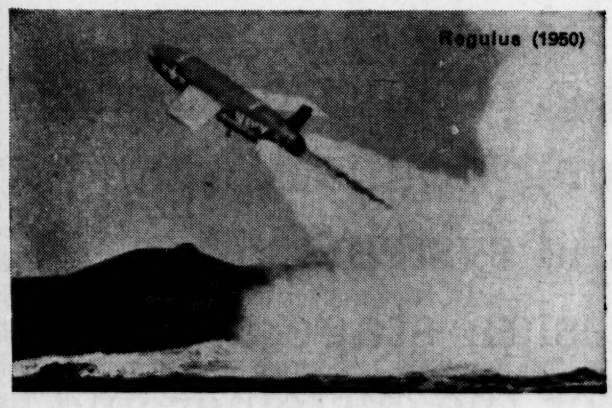
of Naval Aviation



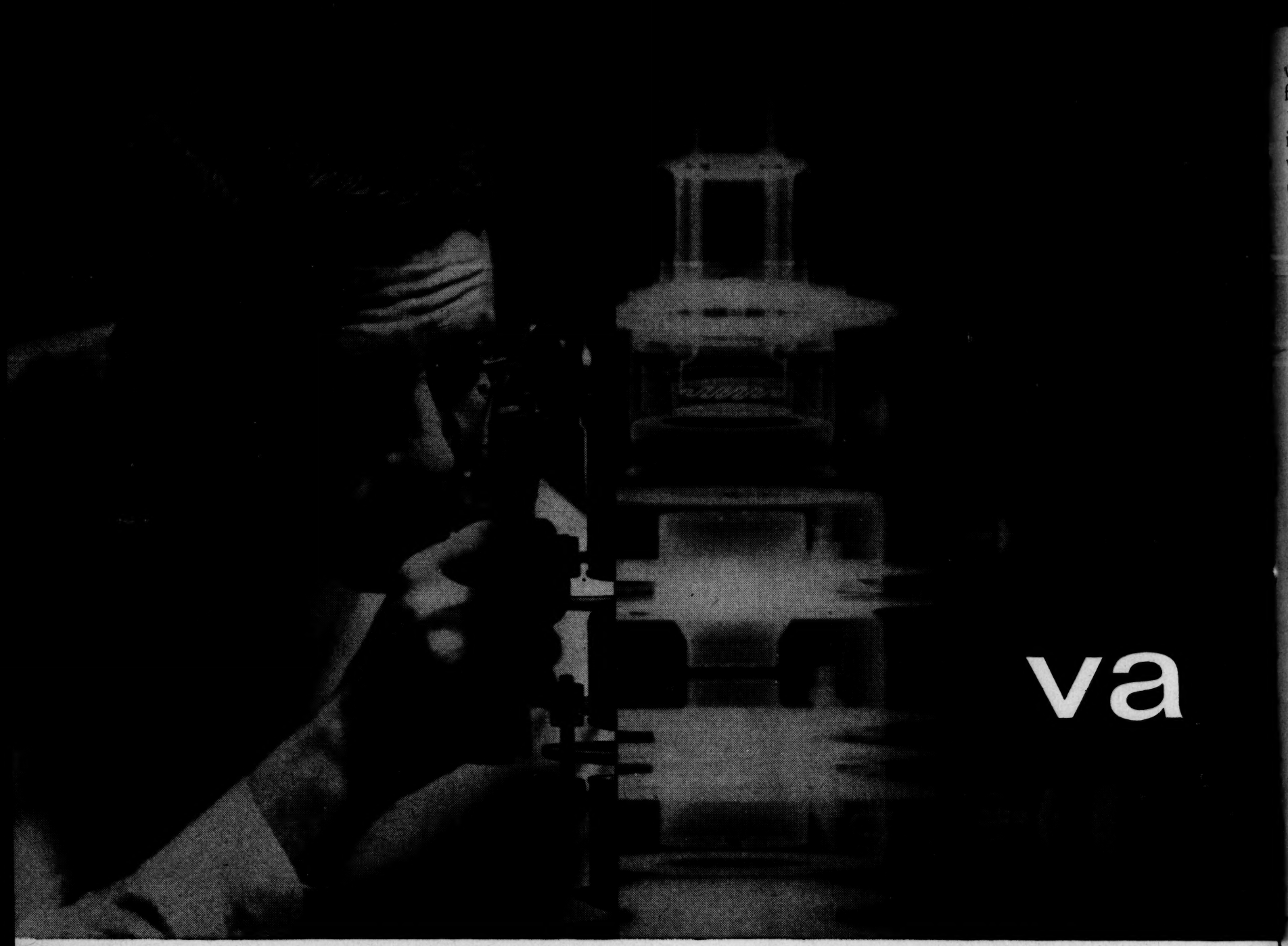


For 40 consecutive years, the Navy and Chance Vought together have strengthened national defense and hastened aviation progress. In 1923, **VE-9s** went aboard the Navy's first commissioned aircraft carrier, the USS Langley, to prove that air power could go to sea. In the **02U-1 Corsair,** received in 1926, Navy pilots captured four world's performance records. Pilots of the **F4U Corsair** fighter registered an 11-to-1 kill ratio during World War II, and the **Corsair** remained in production 11 years—longer than any U. S. fighter before or since. In 1953, the **Regulus** attack missile presaged a mighty deterrent with its first successful launch from a submarine. In 1957, carrier striking speed shot past 1,000-mph with delivery on the **F8U Crusader.** Today, Navy and Marine Corps fliers maintain the Free World's borderwatch in more than 700 **Crusaders.** Tomorrow? Wherever the next big challenge lies—in manned space flight, or in further mastery of the atmosphere—Chance Vought is equipped to help add more great hours to the history of Naval Aviation.

NAVAL 50th ANNIVERSARY 1911 1961 AVIATION

CHANCE VOUGHT CORPORATION




*Value Analysis (VA)* is an X-ray-like Sperry program designed to take a "second look" at products in the hardware stage. Every component part, material and production technique is challenged. The objective: lowest product cost at no sacrifice to essential quality and performance.

Sperry VA teams—specialists in engineering, product methods, purchasing and quality control—are attaining dramatic reductions in costs in a wide range of products and systems.

By introducing value analysis in the design stage as well, additional millions of dollars will be saved for the customer and the taxpayer. General offices: Great Neck, N. Y.

Some typical Sperry programs benefiting from Value Analysis: (left to right) SP-3 Automatic Pilot for light aircraft; Army's SERGEANT missile system; Navy's Mark 19 Gyro-Compass; USAF's APN-59 Airborne Radar System; Klystron tubes for long range radar systems (main illustration).

SPERRY

would be turned on when the raft inflates.

A number of companies, interested in rescue beacon work, have been developing devices for this application over the past years.

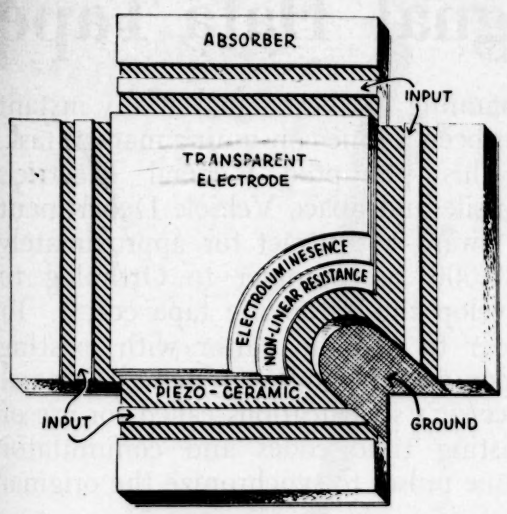
In the past, the relatively large, bulky "Gibson Girl" rescue beacon was generally standard equipment for the life rafts of commercial planes on overwater flights. Operation of the "Gibson Girl," it has long been felt, places too great a demand on distressed people who may be sick or injured in a life raft. About a year ago, however, United Air Lines made Granger Associates ARB 117 automatically operated rescue beacon standard equipment for the life rafts in its planes on transpacific flights (AW Mar. 14, 1960, p. 53). The Granger beacon currently is on consignment with other international air carriers and is carried on a number of executive aircraft.

Granger Associates beacon weighs 9½ lb., transmits on 121.5 mc. for up to 48 hr., and has a 150-mi. range for aircraft at 10,000-ft. altitudes. Hycon Mfg. is making what it regards as a competitive beacon with comparable operating characteristics which weighs about 4.5 lb. Like the Granger beacon, the Hycon device will operate automatically when it lands in water.

Douglas also is developing a beacon package which can be mounted on the tip of the vertical stabilizer of an aircraft. The package is activated on longitudinal impact, a disengaging switch is initiated and a small rocket fires the package into the air where a small parachute opens and brings the package to a soft landing. The balloon antenna inflates and the beacon goes on the air. Present plans, Douglas engineers say, envisage a beacon with sufficient batteries for 8 hr. of operation. The company says it hopes to demonstrate the concept in Honolulu during June.

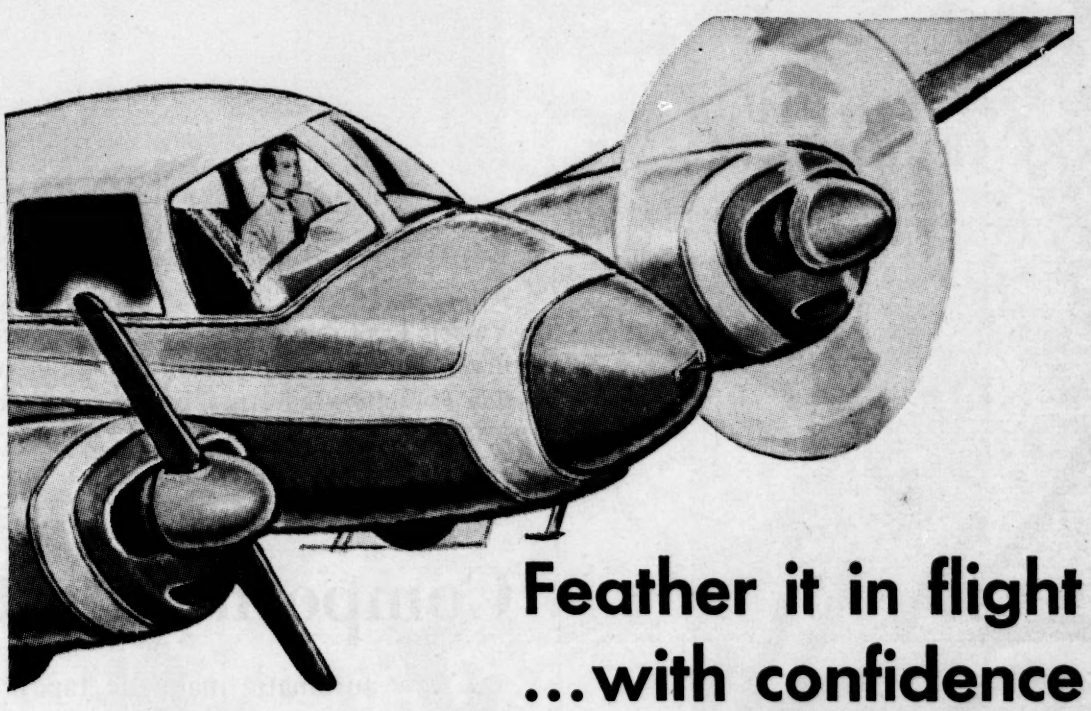
A similar concept for a beacon located on the aircraft's vertical stabilizer was developed some time ago by the Canadian Research Council. Unlike the proposed Douglas device, the Canadian Crash Position Indicator required a special receiver.

Currently and for the past several years there has been considerable amount of activity in the rescue beacon field conducted by the companies already mentioned as well as Fairchild, Philharmonic and Motorola. Much of this work according to some workers in the field is hampered by the essentially unsettled philosophy of whether the beacon belongs to the pilot, his life raft, his ejection seat or none of these.




## New Display Device

Novel piezoelectric-electroluminescence display device uses new principle to produce a moving lighted image. Panel consists of piezoelectric ceramic material, one of whose surfaces is coated with a layer of electroluminescent material. When voltage pulses are applied to electrodes along the edges of the ceramic panel, they produce traveling acoustical waves which interact with electroluminescent layer to produce a spot of light on the panel. Position of the spot is controlled by varying the relative timing of the pulses. Spot intensity is controlled by amplitude of electric field applied to a transparent conductive layer covering the luminescent layer. Device was developed by General Telephone & Electronics Laboratories and reported during recent IRE Convention.

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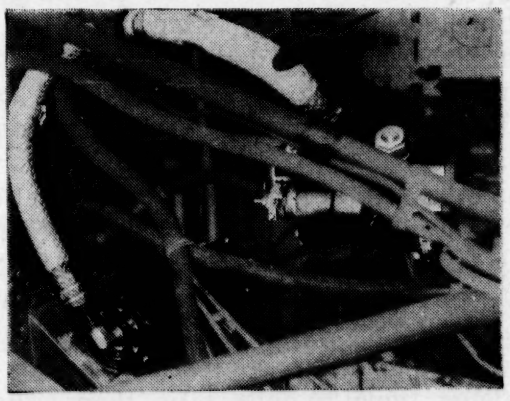
**WOODWARD UNFEATHERING ACCUMULATOR**



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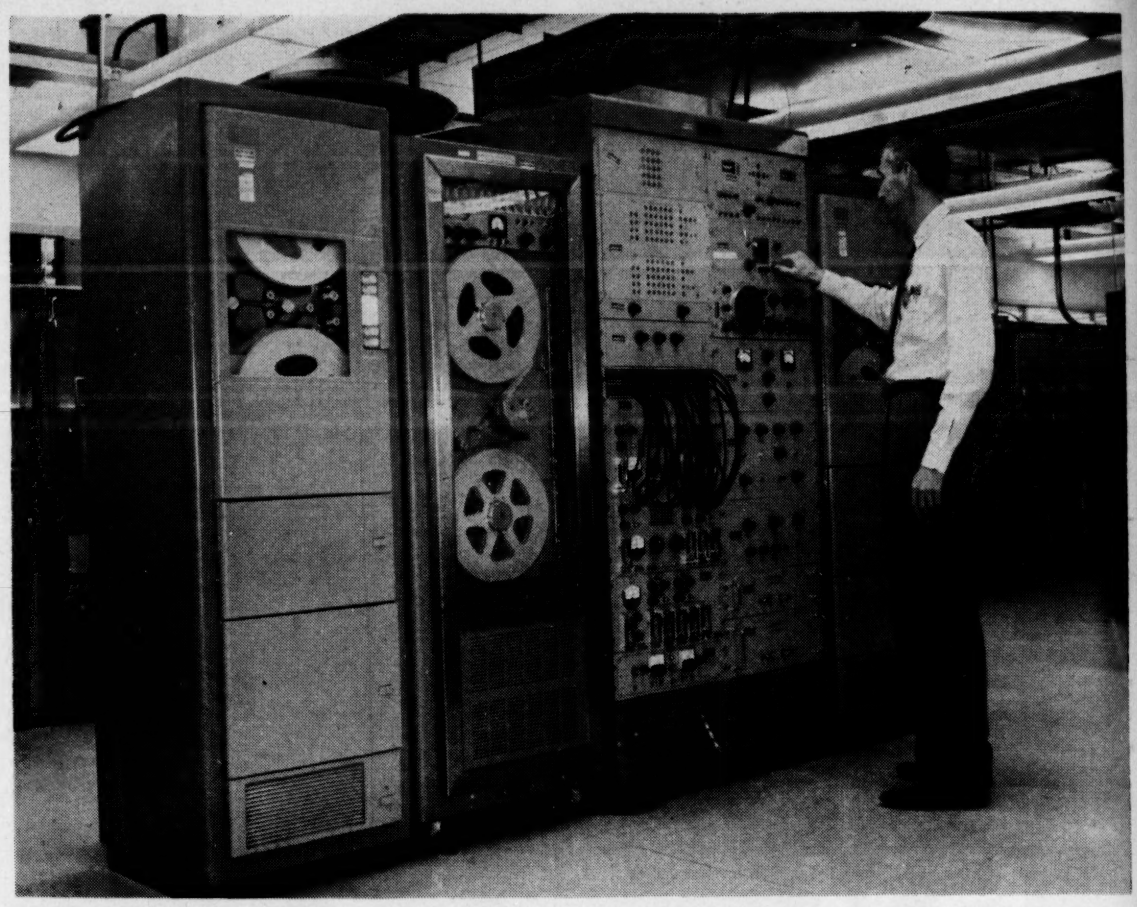


**AUTOMATIC TELEMETRY** tape editor, now in operation at GE's Missile and Space Vehicle Dept., produces a single composite "best signal" data tape from two magnetic tapes made simultaneously at two separate ground stations. Editor, developed by Ortholog Division of Gulton Industries, is shown between tape transport mechanisms at MSVD.

# Telemetry Tape Editor Produces Composite 'Best Signal' Data Tape

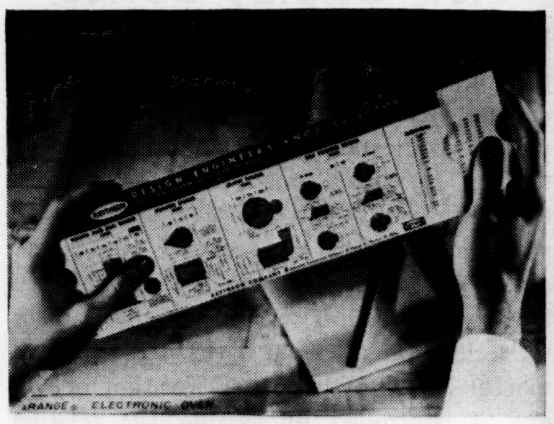
A new automatic magnetic tape editor, expected to slash the time previously required to combine telemetry data recorded simultaneously at several different ground stations, recently went into operation at General Electric's Missile and Space Vehicle Department.

The new MT-1 tape editor, developed by Gulton Industries' Ortholog Division, continuously scans two telemetry tapes which have been recorded simultaneously at different ground stations, selecting for re-recording on a master tape the data which has the highest signal-to-noise ratio. The editor automatically switches from one tape to another, whenever one has a significantly better signal-to-noise ratio.

Another mode of operation, which General Electric will evaluate, is to directly combine the data from the two original telemetry tapes, with suitable weighting, into a composite that has a higher signal-to-noise ratio than either of the originals.

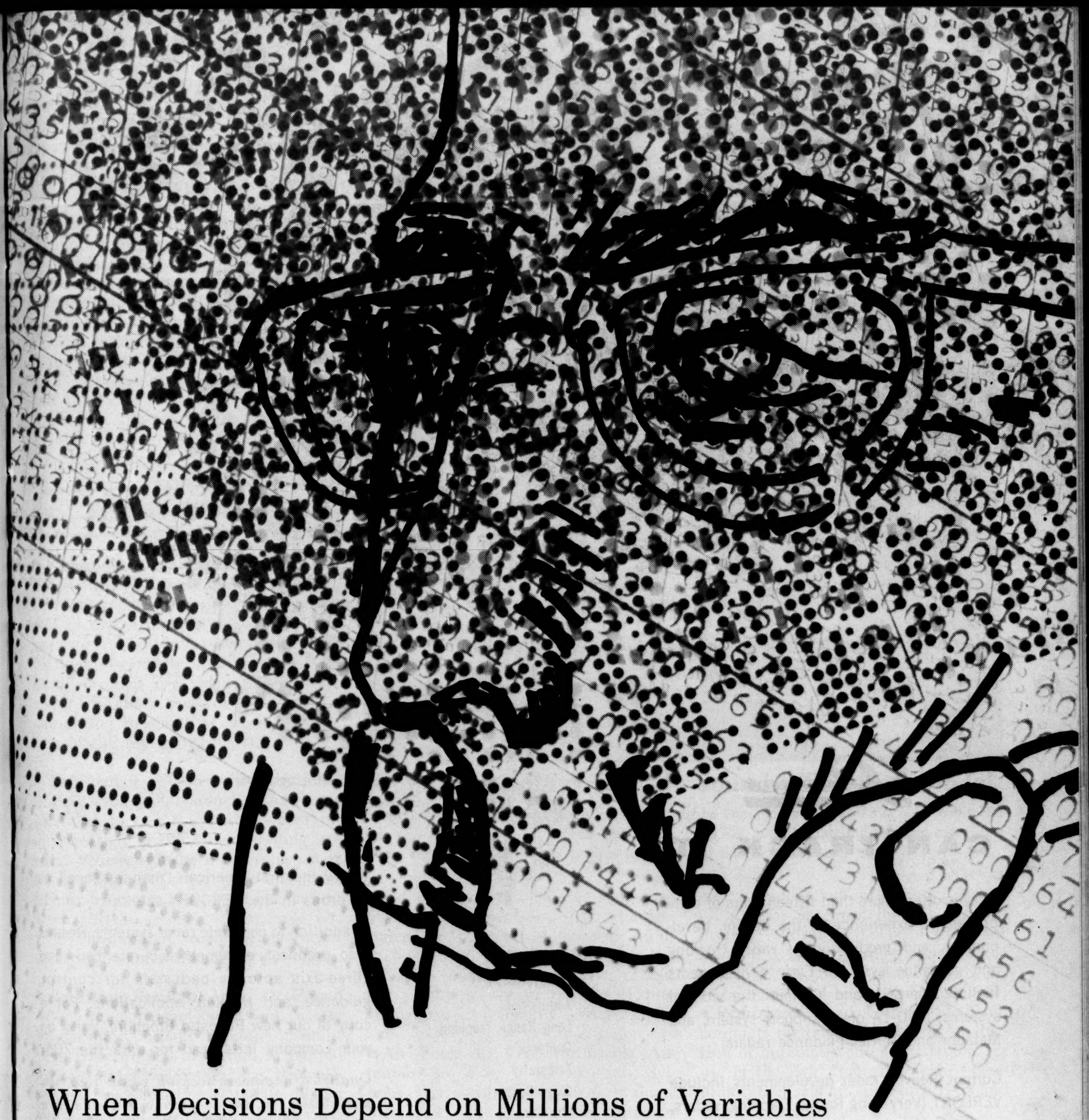
During long-range missile and aerospace vehicle flights, telemetry data normally is recorded at several ground stations for intentional redundancy and because a vehicle quickly moves out of range of a single station at line-of-sight frequencies used for telemetry. Correlating the many telemetry tapes to extract data from the station that is obtaining the best signal at any instant has been a time-consuming manual task.

This prompted General Electric's Missile and Space Vehicle Department to award a contract for approximately $88,000 last summer to Ortholog to develop the automatic tape editor. In order to use the editor with existing tapes and telemetry systems, General Electric's specifications called for use of existing time codes and commutator frame pulses to synchronize the original



## Control Knob Selector

**Control knob selector slide rule for speedy selection of desired style from one of 345 types that meet MS-91528B military specifications. Slide rule, and a wall chart, are available from local franchised Raytheon industrial distributors.**



# When Decisions Depend on Millions of Variables

**The first five minutes of an attack on the North American continent would require the swift response of widely deployed forces. Millions of informational inputs would be automatically channeled into various command headquarters. The assimilation and use of this information for decision and control would depend on vast systems which provide automated information processing assistance to military and governmental leaders. ■ Acting in the public interest, we at System Development Corporation have helped create this new information technology. ■ In developing these systems, we are specifically concerned with the analysis and synthesis of these systems, training men in their use, the instruction of the great computers on which the systems are based – and research into future generations of these systems. ■ The SAGE air defense system is one example involving extensive SDC effort. The new SAC Control System, now in development, is another. Two other extremely large systems are in their initial stages. ■ Our approach to these systems projects is interdisciplinary, spanning Operations Research, Engineering, Human Factors and Computer Programming. To staff our rapidly expanding programs in Santa Monica, Calif., Lexington, Mass., Washington, D. C., and Paramus, N. J., we are seeking scientists and engineers in all these fields. Address Mr. R. W. Frost, 2432 Colorado Avenue, Santa Monica, California.**

SYSTEM DEVELOPMENT CORPORATION

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***Systems that help men make decisions and exert control***

# WHERE...

# WHAT...

# WHO...

***No matter where it's going — what it is — or who it is***

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tapes during editing, according to MSVD's Henry J. Hayes.

For initial alignment and coarse synchronization of the two original tapes, the station time code recorded on the tapes is used. For greater precision, the telemetry commutator frame pulse also is used, permitting the two tapes to be synchronized to within 50 microseconds, according to Arthur Westneat of Ortholog.

The composite tapes can be processed through conventional pulse amplitude and pulse duration modulation (PAM, PDM) decommutators without data dropout, Ortholog says. If desired, the tape editor can be built to automatically edit three or more tapes simultaneously to produce the composite, according to Westneat. Ortholog's address is: P. O. Box 37, Princeton, N. J.

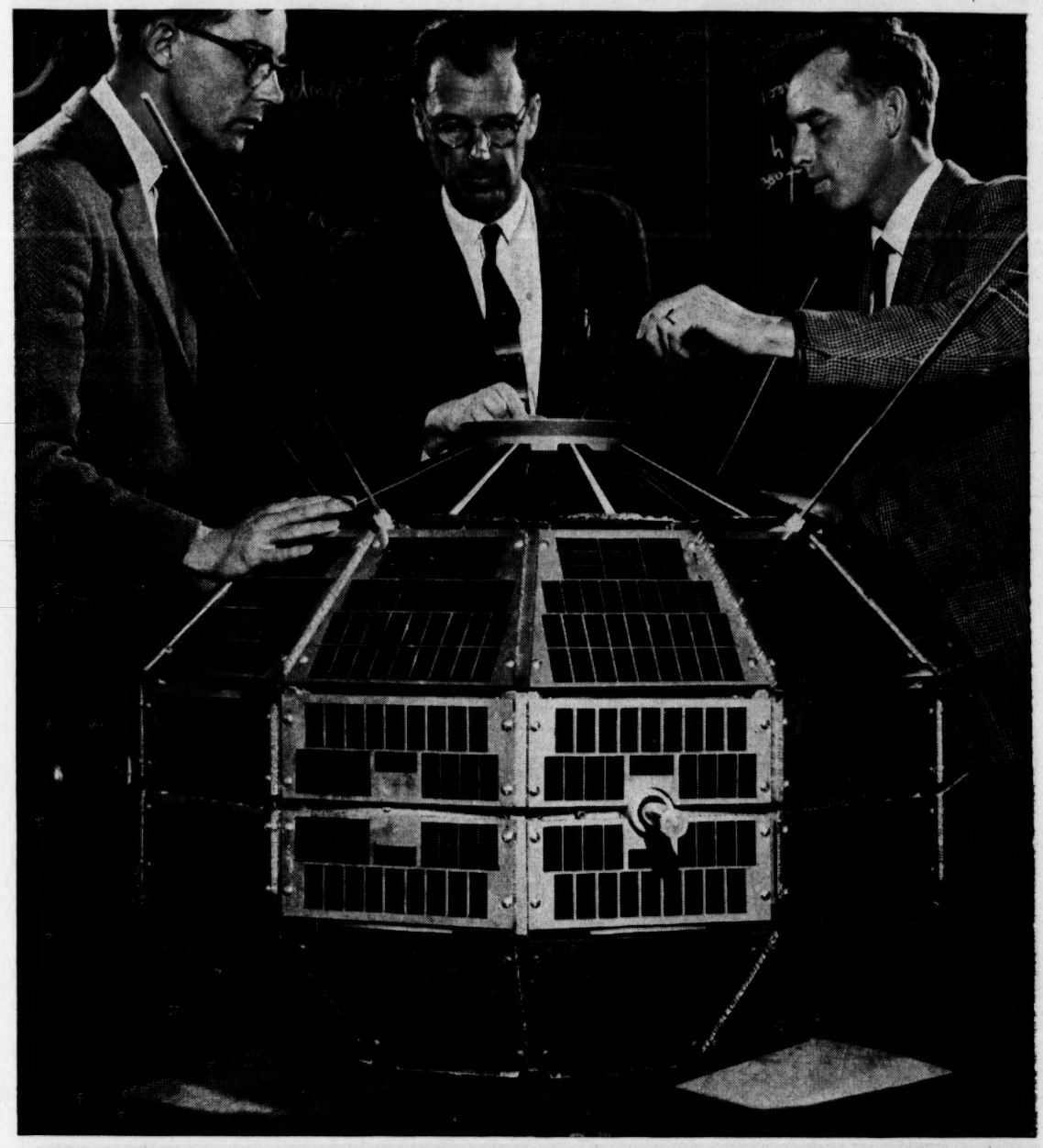
## FILTER CENTER

▶ **Electronic Component Sales Up**—Shipments of electronic components by U.S. manufacturers were up about 4% in fourth quarter of last year over same period in 1959, placing the year's total approximately 10% above 1959. Unfilled orders at the end of 1960 were about 5% above those of a year earlier, amounting to about 11 weeks production at the fourth-quarter rate.

▶ **Transparent Plasma Investigation**—Boeing soon will conduct experiments intended to confirm theory which indicates that plasmas surrounding reentry vehicles can be made transparent to very high frequency radio and radar signals by creating a low-frequency ion wave in the plasma, company's Dr. J. E. Drummond reported at recent meeting of American Physical Society.

▶ **Radiation Resistant Wire Developed**—New irradiated polyolefin wire, whose insulation reportedly is more resistant than conventional insulation to natural and man-made radiation, has been developed by Radiation Materials, Inc., a company jointly owned by Loral Electronics Corp. and Radiation Applications, Inc. New wire is 50% lighter than conventional plastic insulated wire and less expensive, according to manufacturer. Address: 36-40 37th St., Long Island City, N. Y.

▶ **High Temperature Electric Power System**—General Electric has demonstrated an electric power generation system which can operate at temperatures up to 600F, and some components can operate at even higher temperatures. System, known as Hot-Elec, was developed under subcontract to North American Aviation as part of an Air Force sponsored program. The breadboard system, including generator, regulator and controls, has been operated over temperature range of −65F to 600F, GE says. Next step in the GE-NAA program is to construct and test prototype system capable of providing parallel-generator service.



## Canada Displays Topside Sounder Satellite Model

**Model of Canada's topside sounder satellite, to be launched into a 700-mi. polar orbit late this year by a Thor-Delta vehicle (AW Feb. 29, 1960, p. 26). Satellite will use radar in a sweep frequency sounding technique to probe top side of ionosphere.**

▶ **Air Force to Test Unfurlable Antennas**—Air Force's Aeronautical Systems Division, Dayton, will evaluate metalized plastic unfurlable antennas developed by Lockheed Missile and Space Division and Schjeldahl Co., for possible use as space vehicle antennas (AW Apr. 24, p. 83).

▶ **Signed on the Dotted Line**—Major contract awards recently announced by avionics manufacturers include:

• **Electro Nuclear Systems Corp.**, Minneapolis, has received Office of Naval Research contract for study of undersea noise, to be carried out by company's Technical Research Div. in Bethesda, Md.

• **Capehart Corp.**, Richmond Hill, N. Y., two USAF contracts. One for $147,600 from Rome Air Materiel Area, covers production of 41 AT-309A/GPX radar antennas for IFF (identification) purposes. The other for $77,000, is for "Interdict" interference reduction study at 10 Air Force bases, to be completed by end of May, 1961.

• **Remington Rand Univac**, St. Paul, contracts totaling $790,000 for production of automatic antenna couplers for use with high frequency radio communication sets on Air Force B-58 and KC-135 aircraft.

• **Packard Bell Electronics**, Los Angeles, $790,000 from Navy Bureau of Weapons for production of airborne communications and identification equipment.

• **Houston Fearless Corp.**, Beverly Hills, Calif., $1.6 million for design, manufacture and installation of operational support equipment for Discoverer/Samos/Midas program at Lockheed Missile and Space Division.

• **North American Autonetics Div.**, Downey, Calif., $4.2-million Army contract for 25 additional portable precision gyro direction finders, known as ABLE, for establishing artillery emplacements.

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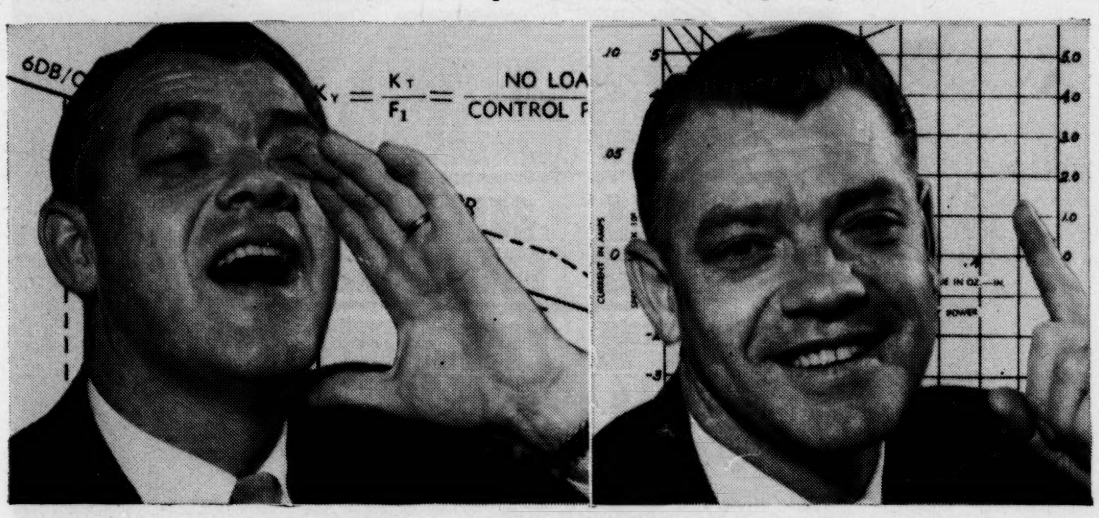

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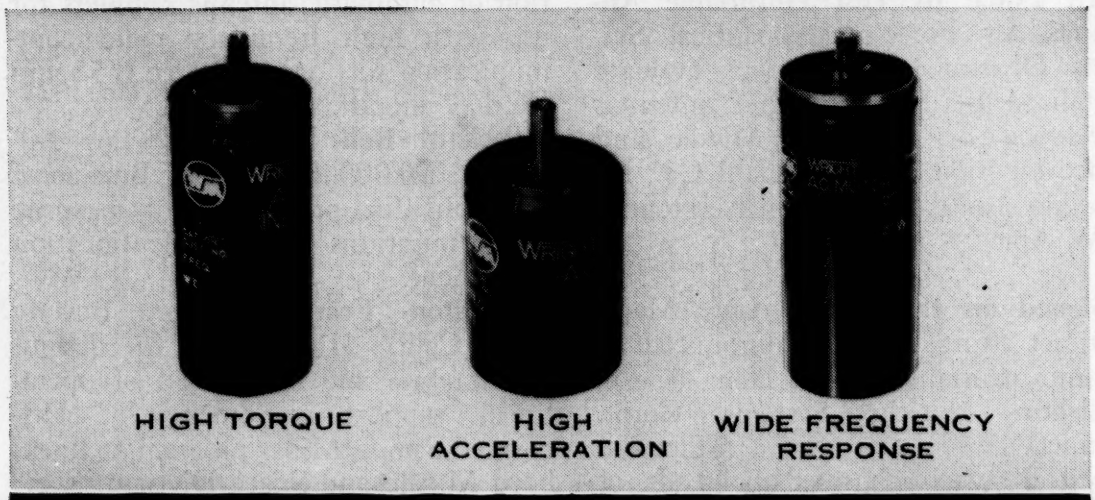


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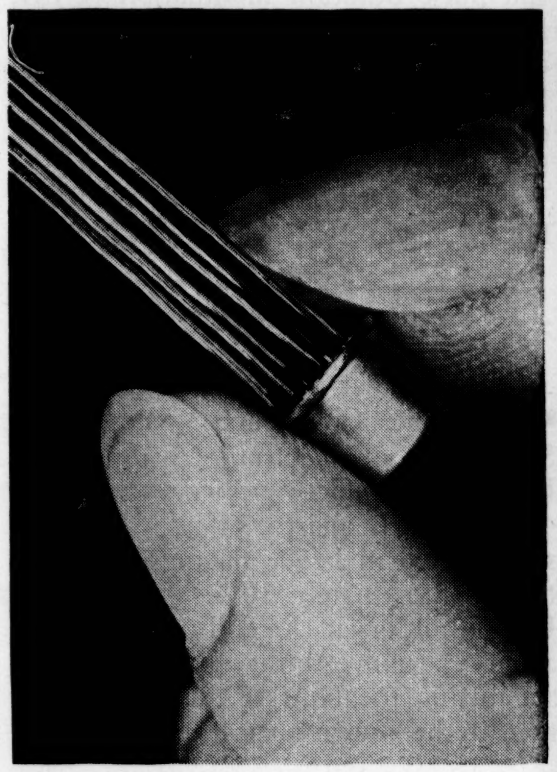
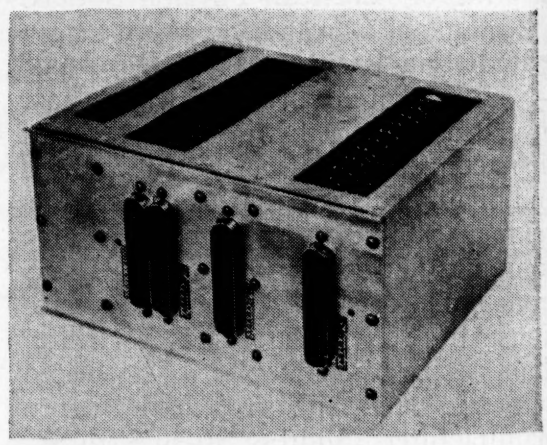
# NEW AVIONIC PRODUCTS

• **Microminiature connectors** which are compression-sealed and will mate with standard corresponding microminiature plastic connectors. Bodies and pins of the connectors are glass-fused. Current rating is 3 amps, voltage breakdown is 1,200 volts rms. at sea level, 350 volts rms. at 60,000 ft. Manufacturer: Escon, Inc., 735 Branch Ave., Providence, R. I.

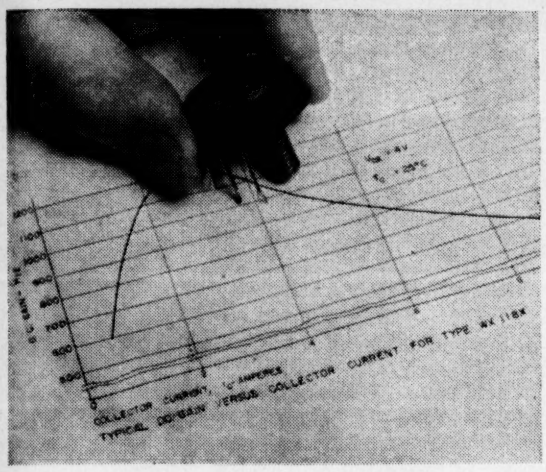


• **Integrated computer NOR logical circuit,** packaged in a TO-5 transistor case, consists of three diodes, an RC coupling network, a transistor and two resistors. All semiconductor elements are fabricated from silicon. Design specifications are available from manufacturer; Raytheon Co., Semiconductor Div., 215 First Ave., Needham, Mass.



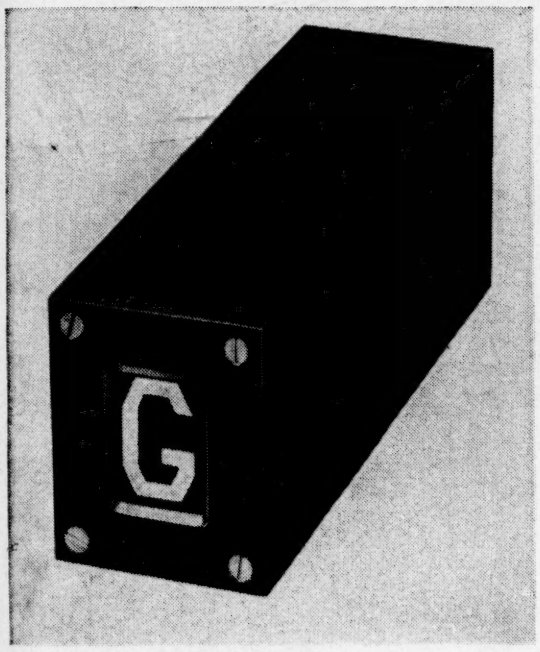
• **Magnetic core memories,** destructive and non-destructive types, for airborne and space applications. Memories provide two microsecond read-write cycles. Current variations of −10% and temperature changes of −30C can be tolerated without external compensation. Manufacturer: Litton Systems, Inc., Woodland Hills, Calif.

• **Power transistors,** Series WX118X and WX118U, are silicon npn. units



with power gains up to 1,000, low saturation resistance and low thermal impedance. These transistors are capable of dissipating 150 w. at case temperatures of 75C; maximum permitted junction temperature is 150C. Thermal impedance is less than ½ deg. C per watt. Manufacturer: Westinghouse Electric Corp., Semiconductor Dept., Youngwood, Pa.

• **Miniature temperature transducer,** resistance type, has sensitive element which measures 0.1 in. dia. and 0.35 in. long. Response time is 20 ms. or less and repeatability is quoted at within 0.05%. Transducer is hermetically sealed to withstand up to 6,000 psi. and meets MIL-E-5272C shock and vibration according to manufacturer: Winsco Instruments & Controls Co., 11789 West Pico Blvd., Los Angeles 64, Calif.



• **Alpha-numeric display model,** Type IL-2000, can display any one of 64 individual characters when operated from a 6-bit binary input, or any one of 16 characters when operated from a 4-bit binary input. Display can change from one character to any other in less than 50 milliseconds and can hold any character on display without drain on input circuit. Device measures 4½ in. long by 1.2 in. high and 1 in. wide and weighs 5½ oz. Display is internally lighted with characters measuring 0.5 in. in height. Manufacturer: Servomechanisms, Inc., 200 N. Aviation Blvd., El Segundo, Calif.

RUGGED

Elapsed Time Indicators

BY ELGIN MICRONICS

This unusual photograph (taken just before Bernard Butterfingers left our shipping room) shows an Elgin Micronics ETI passing the old random sample bounce test. We test against MIL-M-26550 now and surpass the shock and vibration requirements very easily. After all, a 20G, 11ms shock is just a love pat compared to an umpteen G bounce. You'll find Elgin Micronics ETI's surprisingly small and light too, despite their rugged construction—just right for aircraft and missile equipment. Digital or dial read-out models, AC or DC, are available. Write today for specs—ask for bulletin ETI-1.

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# FROM TALENTS TO HARDWARE

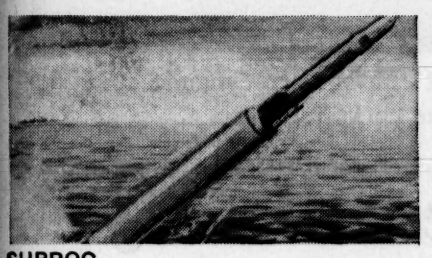
## LOOK TO GENERAL PRECISION FOR DEVELOPMENT, PRODUCTION AND SYSTEMS MANAGEMENT

The talents and capabilities of the four divisions of General Precision, Inc., are heavily represented in the Navy's latest weapons systems, as well as in space-age hardware of all categories. The divisions are responsible for some system, subsystem or component on virtually every missile, rocket, aircraft and spacecraft now in operation or development, including all of the Navy's antisubmarine warfare equipment on surface ships and submarines.

To make these broad capabilities available to the fullest of their combined potential, General Precision, Inc., has consolidated its four divisions for the systems management of major new undersea defense projects and other important weapons and space systems.

A major undersea weapons program can now draw upon more than 2½ million square feet of combined General Precision floor space and over 16,000 General Precision employees, including 4,500 scientists, engineers and technicians.

This combination of talents and facilities, backed by the corporate financial resources of General Precision, Inc., makes it possible to develop, produce and manage an undersea defense system as an integrated package.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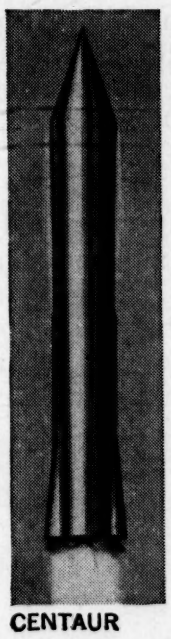
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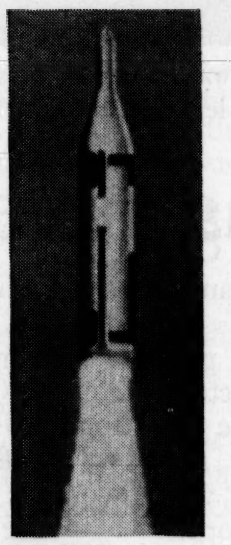
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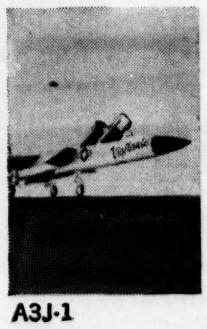
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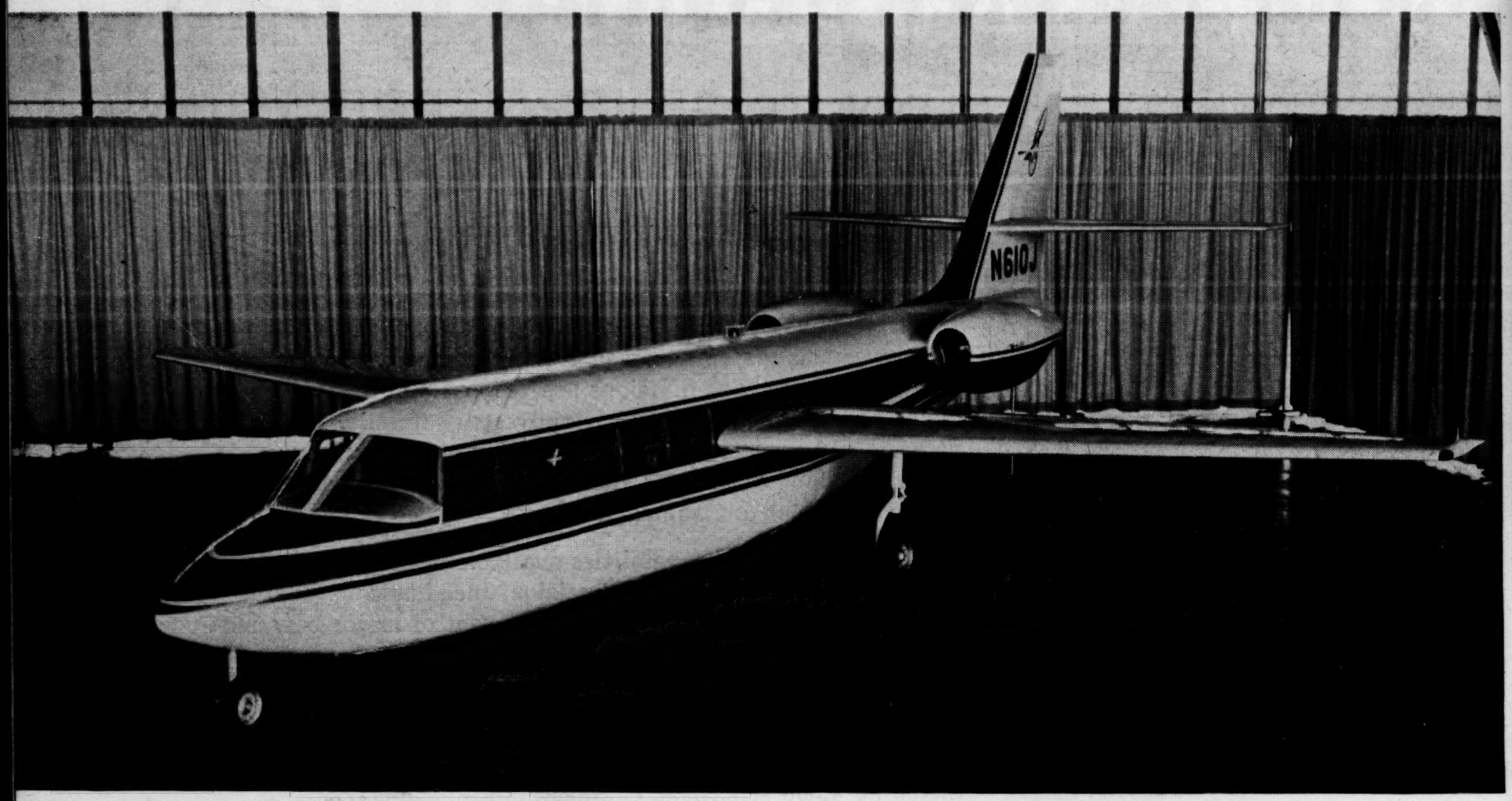



**MID-WING LAYOUT** of Model 1121 Jet Commander, shown on full-size mockup, was chosen as most efficient aerodynamic configuration, obviating extensive filleting. Plug-type entrance door to pressurized cabin is on left side, behind the cockpit.

# Aero Commander Building Executive Jet

**By Erwin J. Bulban**

**Oklahoma City, Okla.**—Parts are being cut here by Aero Commander, Inc., for a new four-to-six passenger twin-jet business plane scheduled to make its first flight in April, 1962.

The company is concurrently planning a production schedule which calls for initial deliveries of certificated Model 1121 Jet Commanders from the factory in the summer or in the fall of 1963.

For a price of approximately $560,000 customers will get an airplane fully equipped with interior and electronics, including radar and distance measuring equipment, powered by two General Electric CJ-610-1 turbojets delivering 2,850 lb. thrust each on takeoff. The airplane will also be available, minus electronics, for approximately $475,000 to those customers who prefer to have custom installations of this equipment made in the field.

## Basic Design Parameters

Basic design parameters are aimed at providing business executives with a private jet certificated to operate at altitudes up to 40,000 ft., capable of cruising at Mach 0.8 at 20,000 ft. and above, having a range of better than 1,500 mi. with adequate fuel reserves and with the ability to operate from any airport now used by the company's piston-engine Commanders.

Typical flight profiles and other performance discussed here at the factory with AVIATION WEEK point up the Jet Commander's capabilities and the transportation advantages that will be provided business executives operating this class of private jet:

• **Los Angeles-Oklahoma City** flight, covering 1,025 naut. mi., would take 2.18 hr. from takeoff to landing. Jet Commander could leave Los Angeles at gross weight of 14,000 lb., climb at maximum continuous engine rpm. to 35,000 ft. cruise altitude, covering 70 naut. mi. in the climb to level-out, using 740 lb. of fuel in the process and gaining cruise altitude in 0.23 hr. from sea level.

At 35,000-ft. optimum cruise altitude, the Jet Commander would fly to Amarillo, a distance of 766 naut. mi., cruising at 500 mph. true airspeed. Letdown would start at Amarillo, which the airplane reached in 1.76 hr., having used 2,690 lb. of kerosene fuel. Descent at Amarillo would be made to 5,000 ft. at a speed of 287.5 mph., using 813 lb. of fuel during the descent, which is accomplished in 0.57 hr. There is an allowance of five minutes holding at the 5,000-ft. altitude to orient over the omni, at 230 mph., using 140 lb. of fuel in the process, then descent into Oklahoma City Airport, allowing 10 min. for this and using 157 lb. of fuel.

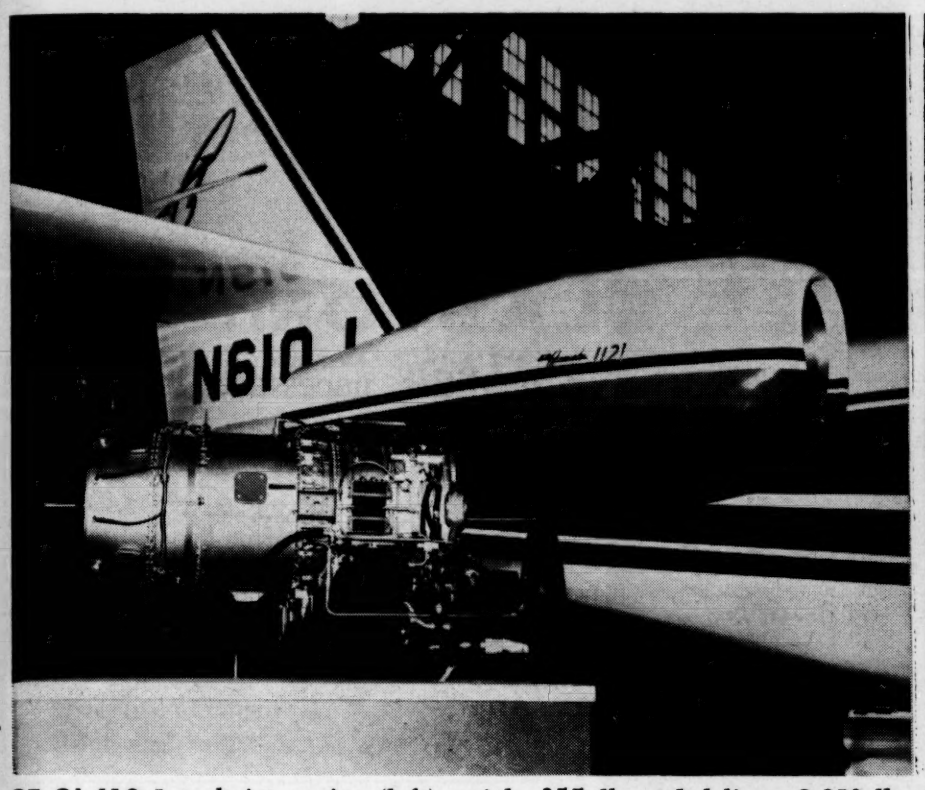
Fuel reserve at the end of the Los Angeles-Oklahoma City flight would total 1,642 lb.

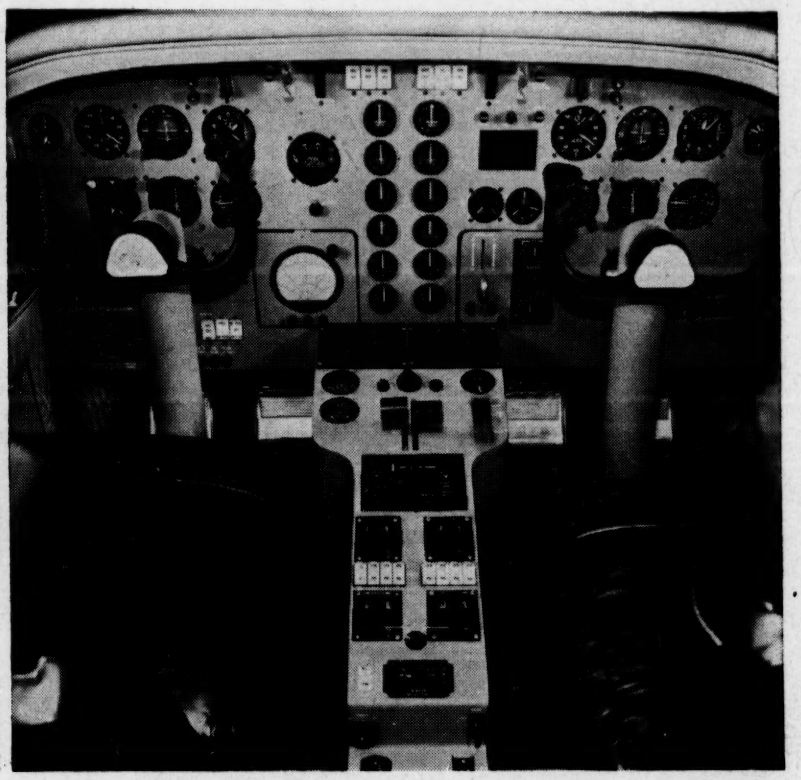
• **Takeoff distance** of 1,900 ft. will be required on a normal day at sea level, with the airplane at a gross weight of 14,000 lb., utilizing normal technique and rotating the nose at 131 mph. Using short-field technique, takeoff distance would be approximately 1,500 ft. On a 100F day at sea level, the airplane could be lifted off at full gross with normal technique in 2,538 ft., Aero design calculates.

When operating from a 5,000-ft. altitude runway, the Jet Commander will get off the ground on a standard day at full gross in 2,703 ft. and on a 100-deg. day in 3,390 ft., using normal technique in these cases.

• **Climb performance** for the Model 1121 indicates that on two engines, the airplane will climb from sea level at 7,000 fpm., and at 35,000 ft., it can climb at the rate of 1,000 fpm., both performances calculated on the basis of full gross weight. Maximum climb speed on two engines at sea level is 342.3 mph.

Single-engine rate of climb at 14,000 lb. weight is approximately 2,100 fpm., with single-engine maximum climb speed being 247 mph. at sea level.





**GE CJ-610-1** turbojet engine (left) weighs 355 lb. and delivers 2,850 lb. thrust on takeoff. It will be FAA-certificated this year. Cockpit presentation provides engine and communications controls on central pedestal. X-band radar is part of standard equipment.

Airplane is designed for a single engine ceiling of 35,000 ft. at 10,000 lb. weight. Ceiling on two engines, at 14,000-lb. gross weight, is 40,000 ft., at 12,500 lb. it is estimated as 43,000 ft., at 10,000 lb. weight it is estimated as 45,000 ft. and at 8,000 lb. weight the ceiling is estimated as 47,000 ft.

• **Stall speed**, power off, in the landing configuration and at approximately 7,500-8,000-lb. landing weight, is estimated as 69 mph.

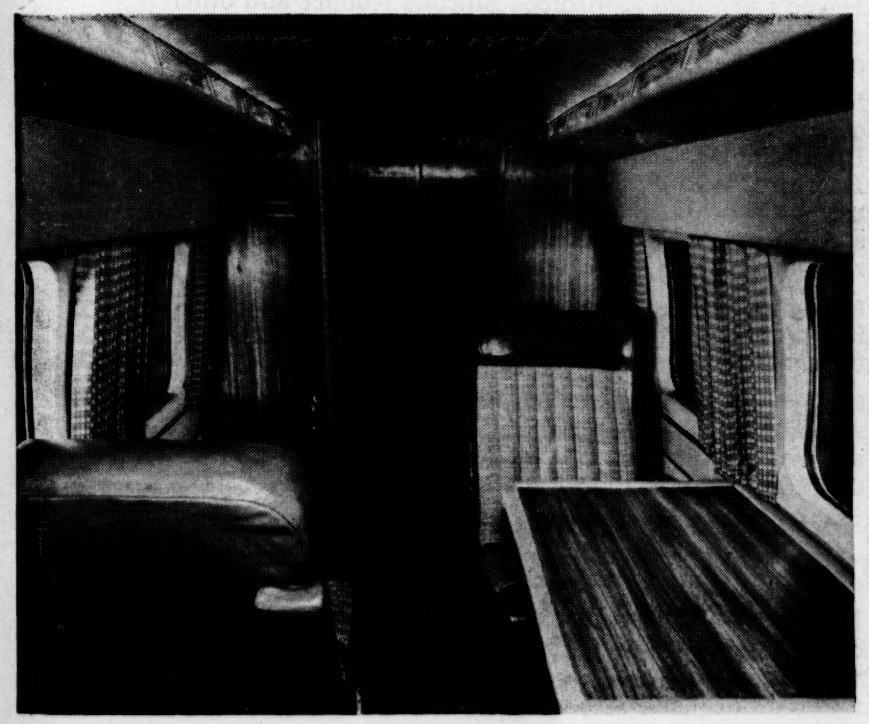
Company executives here, from vice-president-general manager Tom Harris on down, emphasized to AVIATION WEEK that Aero Commander was in this program hard, with both feet. Convinced that a vacuum now exists for a pure-jet-powered executive transport in this class, that such an airplane is technically feasible due to availability of the proper powerplants, management feels that sooner or later some manufacturer is going to move to fill the gap that exists and it has moved to grab the initiative.

Aero Commander feels that there is going to be a limited market, at least for the first two or three years, for this size-and-price-class airplane, and the first company to provide a suitable vehicle is going to establish an unshakable commanding position in the market. The company likens the situation to that which existed prior to the advent of the first jet-powered U.S. airliner and points to the top-dog position achieved by Boeing as a result of chopping off the market survey processes and committing the company to a firm jetliner program in advance of its competition, then pouring funds into the program and refusing to be "scared out" by other contenders.

Indications are that Aero commander feels that its size and management makeup allows it to move faster and at lower overhead costs than possible U.S. competition.

Two projects in this area are the North American T-39 and the Douglas-Piaggio airplanes (AW May 1, p. 47). It thinks that it also can beat foreign programs, such as the Swiss SAAC-23, the Israeli B-101C, the Heinkel-Potez CM-191 and the Hawker-Siddeley DH-125 on the basis of natural U.S. resistance to foreign aircraft or low production capability.

Decision to go ahead and begin spending company funds on the Model 1121 was made a year ago and the company started work on the first of a series of mockups last fall—it unveiled the final production configuration mockup to its distributor-dealer organi-



**CABIN** is approximately 4½ in. wider and 8 in. higher than Model 680F Commander. It seats four in standard layout, six for high density. Galley is between cabin and cockpit, separated by door. Passengers have automatically-dispensed emergency oxygen system.

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## Group Weight Breakdown

| | |
|---|---|
| **Airframe Group** | |
| Wing | 1,114 lb. |
| Empennage | 320 lb. |
| Fuselage | 1,443 lb. |
| Landing gear | 510 lb. |
| Upholstery | 557 lb. |
| Controls | 200 lb. |
| Propulsion | 1,010 lb. |
| **Equipment Group** | |
| Fluid system | 159 lb. |
| Electrical equipment | 461 lb. |
| Instrument panel | 100 lb. |
| Radar | 85 lb. |
| Battery | 110 lb. |
| Pressurization equipment | 175 lb. |
| Oxygen equipment | 56 lb. |
| Paint and misc. | 40 lb. |

zation at a factory meeting earlier this month.

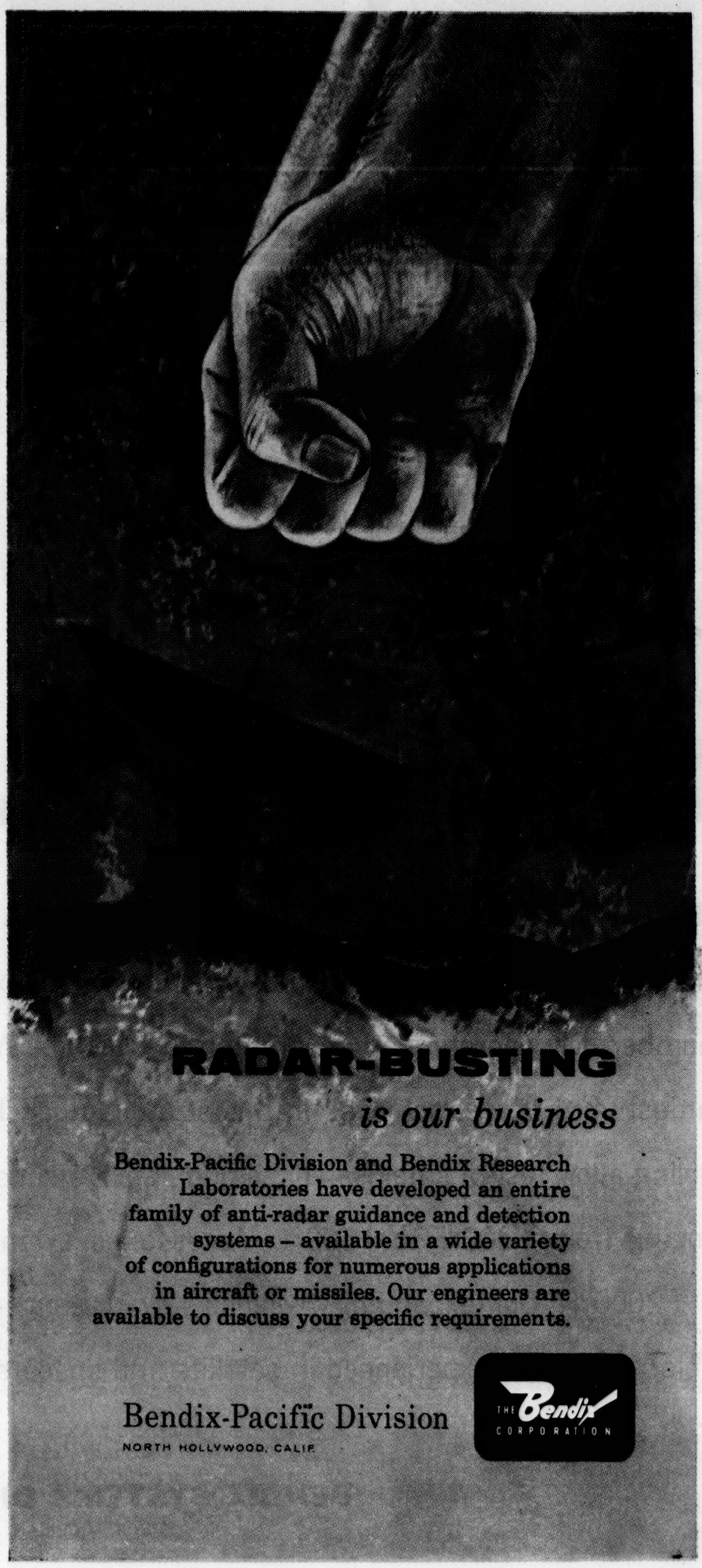
Company has been conducting market surveys for years, including those made for it by outside firms, but it frankly admits that beyond indications that there is a need for such an airplane, there is a large element of gamble in that it will have to develop the market itself over a period of years and it cannot now predict backlogs.

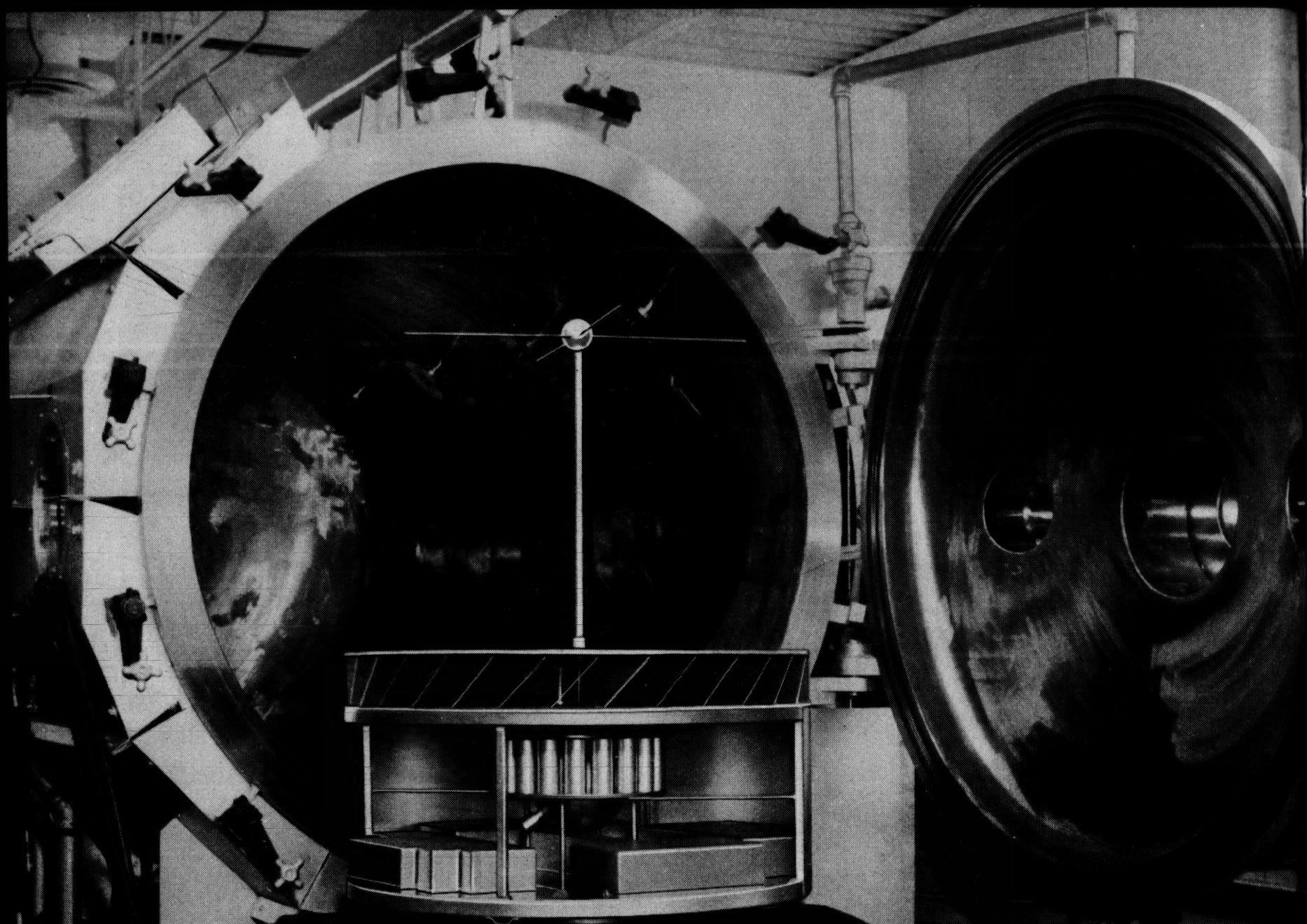
Engineering department is moving at an accelerated pace into developing the airplane; vice president-engineering Ted Smith indicated that a personnel buildup is under way to keep the project moving on schedule.

In keeping with Aero Commander's previous practice, the initial production prototype Model 1121 will be built at the company's Norman, Okla., development and engineering center, and as usual, accent will be on getting the first airplane built and flying as quickly as possible, with a minimum of wind tunnel research. Smith pointed out that this practice has been very effective in the past in speeding the development-to-production cycle and that the company's experience in using full-scale prototypes rather than extensive initial wind tunnel studies has been very successful. The designer can go only so far in the wind tunnel collecting firm data and from there on much of the data is largely theoretical and may not prove out well when the prototype takes to the air, he notes. Comparative cost of modifying past full-scale prototypes as against the cost of long detailed wind tunnel programs is very favorable, he feels.

Some wind tunnel studies will be made at the University of Oklahoma's 200-mph. tunnel, using a 1/10th scale model for flow studies.

Actually, the airplane does not reach into the performance area where exotic



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## Model 1121
## Jet Commander

| | |
|---|---|
| Wingspan | 43.31 ft. |
| Length | 48 ft. |
| Height | 14.75 ft. |
| Gross wing area | 303.3 sq. ft. |
| Wing airfoil section | NASA 64 A 212 |
| Wing aspect ratio | 6.19 |
| Wing taper ratio | 0.33 |
| Sweep angle of quarter chord line | 4.63 deg. |
| Total aileron area (2) | 19.24 sq. ft. |
| Total horizontal tail area | 70.08 sq. ft. |
| Total elevator area (2) | 17.21 sq. ft. |
| Total vertical tail area | 48.60 sq. ft. |
| Rudder area (including tab) | 11.41 sq. ft. |
| Aileron span | 91 in. |
| Rudder span | 67 in. |
| Elevator span | 98 in. |
| Horizontal tail aspect ratio | 5.333 |
| Horizontal tail taper ratio | 0.50 |
| Horizontal tail airfoil section | NASA 64 A 010 |
| Vertical tail aspect ratio | 1.651 |
| Vertical tail taper ratio | 0.3704 |
| Vertical tail airfoil section | NASA 64 A 010 |
| Fuselage wetted area | 614.97 sq. ft. |
| Wing wetted area | 526.15 sq. ft. |
| Vertical tail wetted area | 99.14 sq. ft. |
| Horizontal tail wetted area | 142.97 sq. ft. |
| Nacelle wetted area (2) | 125.86 sq. ft. |
| Nacelle strut wetted area (2) | 37.40 sq. ft. |
| Empty weight | 7,500 lb. |
| Maximum gross weight | 14,000 lb. |
| Fuel capacity (kerosene) | 950 gal. |
| Cabin height (inside) | 59.50 in. |
| Cabin width (inside) | 56.50 in. |
| Passenger compartment length | 101.75 in. |
| Lavatory | 27 x 56.5 x 59 in. |

design tricks need to be incorporated, such as droop leading edges, complex flap and aileron systems and the like, and much of the design may be considered straightforward.

Smith emphasized that a primary aim was to develop an airplane requiring a minimum of transition time on the part of a piston engine pilot. Indications are that the airplane was developed considering transition from the Commander 680F. Smith feels that a good 680F pilot's main concern in making the transition to the Model 1121 will be in recognizing that he is flying at more than twice the speed of the piston airplane, that approach maneuvering will take more area, technique must be developed to come down from high speed flight to approach pattern speeds smoothly and more careful flight planning is required. In the low-speed regime the jet airplane should pose no difficult handling problems. Smith pointed out that the Model 1121 has a wing loading of some 24.3 lb./sq. ft. at landing weight compared with approximately 24 lb. for the Model 680F at landing weight. Even at gross weights, there is no radical variance in wing loadings, the Model 1121 having 46 lb./sq. ft. at 14,000 lb. gross weight as against 32 lb./sq. ft. for the 8,000-lb. Model 680F.

Other design characteristics are also similar. Fuel management system on the jet, for example, will be nearly identical with that used on the Model 680F.

Final configuration is the culmination of studies going back some seven or eight years, including early thoughts on adapting the piston-engine, high-wing airplane to jet power by hanging Turbomeca jets under the wings in pods.

But design limitations permitted performance gains that did not warrant the cost of such a program. More sophisticated was a layout designated TJ-6000 planned in 1958 which bears some resemblance to the Model 1121, but which was a high-wing airplane, with two GE CJ-610 or two P&WA JT-12 turbojets buried in the fuselage behind the cabin, fed by inlets in the leading edges of the wings at the roots and having twin tailpipes exhausting out of the rear of the fuselage. Landing gear is retracted into the bottom of the fuselage.

Analysis indicated serious ducting losses because of the need to bend airflow from inlets to engine intakes and long tailpipes, necessity for a relatively complex wing structure to take spars around the inlets, some resistance to having engines buried near the cabin area because of possible crash hazards and greater complexity in landing gear design. Indications are that this layout would have resulted in an airframe costing at least $50,000-$75,000 more than the current configuration.

### Aft Engine Design

Design analysis indicated benefits of putting engines in pods on rear of the fuselage—permitting a clean wing layout, less likelihood of ingesting foreign objects, reduction in noise level in cockpit and cabin—placing wing in near mid-fuselage location for maximum aerodynamic efficiencies and minimum flow interference with engine inlets.

Initially, both the GE CJ-610 and P&WA JT-12 powerplants were considered since thrust performance was so similar that there would be relatively minor design problems in fitting either type. Indications are that Aero Commander considered using the CJ-610 as the standard engine, making the JT-12 optional if the customer desired to pay a higher price, but then a few weeks ago, P&WA made a price increase of some $6,000 on the JT-12 and the airframe manufacturer felt it could no longer consider offering this engine as


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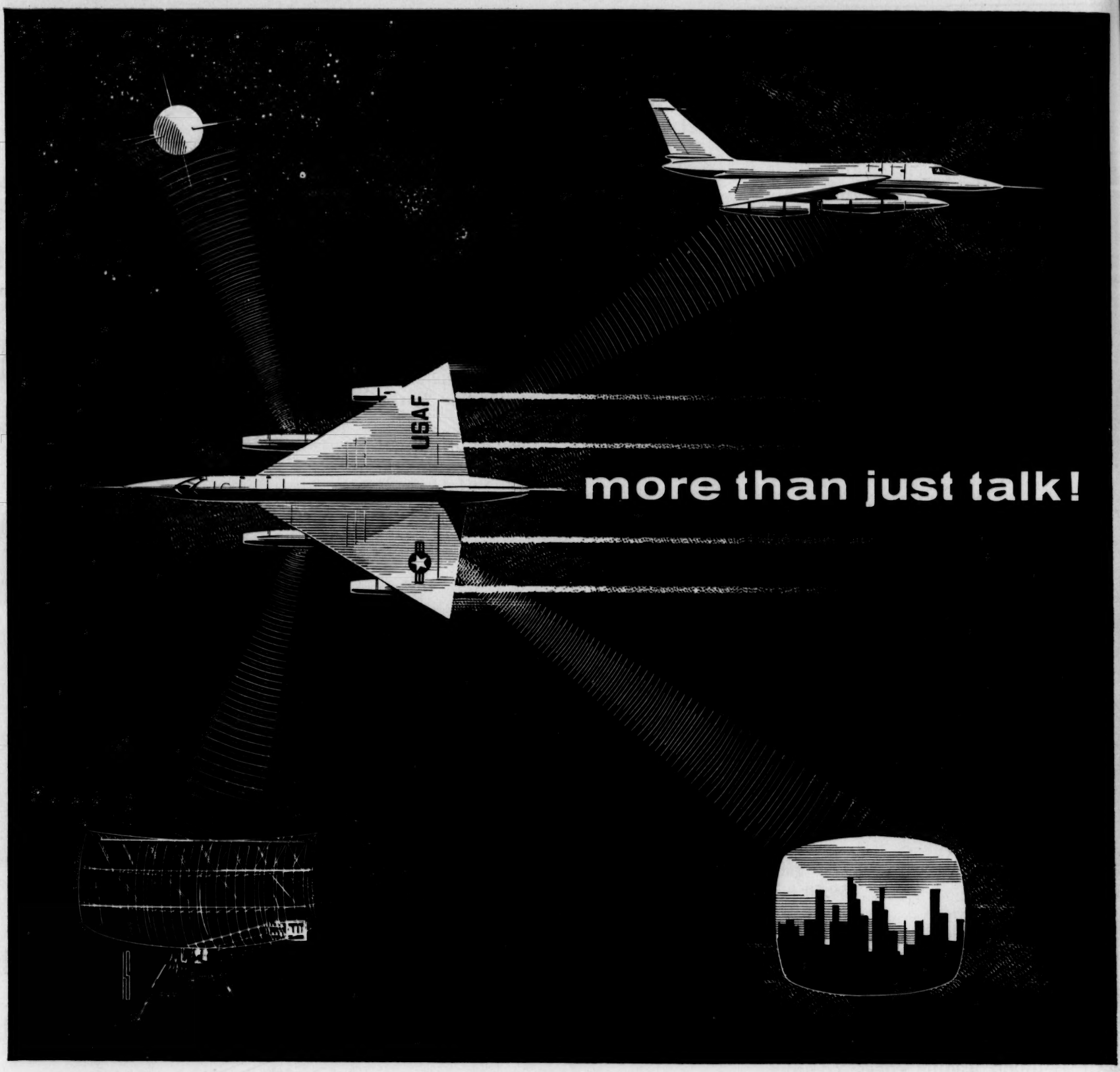


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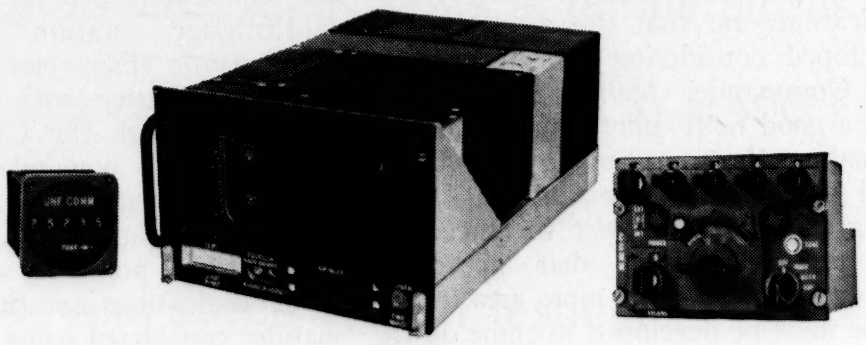

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part of the Model 1121 program.

Wing geometry comprises two main panels permanently joined at the fuselage center line behind the cabin. There are two main spars, a sub-spar carrying attach points for main landing gear and flaps, and bulkheads approximately 16-in. to 32-in. apart. Spars will be machined in one piece from forgings and/or billets or plate and will incorporate integral spar cap flanges, shear webs and all stiffening members. Wing skins will also be machined from aluminum alloy plates, starting with one-inch stock, working excess material off so that the skins are tapered from 0.09 at the root to 0.04 at the wingtips. Leading edges will be similarly machined, with integral stiffeners, except that these stop at the leading edge radius to permit bending the skin to the proper contour. All wing cut-out areas, where access doors are to be fitted, will also be integrally reinforced using machining processes.

All structures will be sealed to permit using the entire wing as an integral fuel tank. Fuel tank system, providing a total of 950 gal. of kerosene storage, will comprise three tanks. A 225-gal. center tank will be located in the fuselage area and rubber cell encased to reduce possible strain hazards encountered in a crash. There will be two interconnected outer tanks. Center tank would be used for takeoff and cruise; at the end of the flight the pilot would switch to the right and left outboard tanks.

Simple, split-type wing flaps, comprising some 53% of each wing panel semi-span, are fitted at 75% of the chord line and can be depressed 50 deg. Ailerons are 100% mass-balanced and cover approximately 35% of the semi-span of the wing panel. In addition, the ailerons contain an 8% aerodynamic balance. Wingtips are built up of reinforced plastic and are approximately 8 in. long.

Tail structure is similar to the wing layout, using two spars, machined to provide integral spar caps, shear webs

## Subcontracting Required

Oklahoma City, Okla.—Integrally stiffened makeup of Model 1121 Jet Commander wing skins and fuselage frames will require subcontracting of these components to firms having specialized production machines capable of forming these parts, since Aero Commander does not yet own such equipment. The procedure probably will also apply to the airplane's wing spars, although Aero Commander possibly may do this work after the initial airplanes are built. Primary materials used in the airplane are 2024, 7075 and 7178 aluminum alloys.


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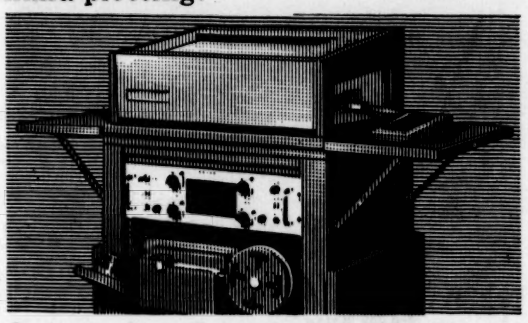

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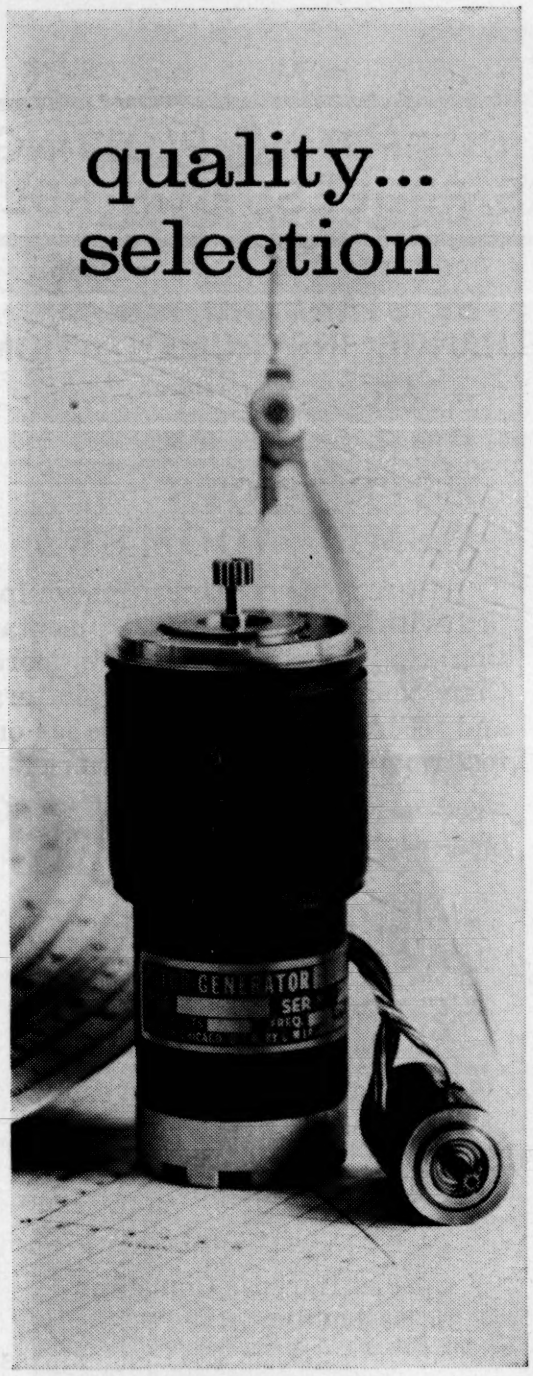


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| Make and Model | No. of Units | Net Billings |
|---|---|---|
| Beech 18 Super | 5 | |
| 33 Debonair | 11 | |
| 35 Bonanza | 30 | |
| 50 Twin-Bonanza | 6 | $3,657,000 |
| 55 Baron | 20 | |
| 65 Queen Air | 5 | |
| 95 Travel Air | 1 | |
| Call Air A-5, A-6 | 0 | $0 |
| Cessna 150 | 19 | |
| 172, Skyhawk | 67 | |
| 175, Skylark | 10 | |
| 180 | 12 | $3,609,000 |
| 182, Skylane | 70 | |
| 210 | 23 | |
| 310 | 23 | |
| Champion | N.R. | N.R. |
| Commander 500 A, E | 3 | |
| 560 E, F | 6 | $862,000 |
| 680 E, F | 2 | |
| 720 | 0 | |
| Lake LA-4 | 1 | $23,000 |
| Mooney Mark 21 | 12 | $231,000 |
| Piper PA-18 Super Cub 95 | 3 | |
| PA-18 Super Cub 150 | 6 | |
| PA-22 Tri-Pacer | 3 | |
| PA-22 Colt | 101 | |
| PA-23 Apache | 6 | $2,528,000 |
| PA-23 Aztec | 19 | |
| PA-24 Comanche 180 | 11 | |
| PA-24 Comanche 250 | 44 | |
| PA-25 Pawnee | 12 | |
| Totals | 531 | $10,910,000 |

**Note: Deliveries for the first two months of Calendar 1961 totaled 1,185 units having a factory billing value of $23,163,000. In the same period last year, 1,512 units were delivered with a factory billing value of $28,443,000. In the first two months of this year Beech delivered 162 units valued at $7,045,000, compared with 176 units valued at $7,337,000 in the same period 1960; Cessna 537 units valued at $8,220,000 vs. 705 valued at $11,308,000; and Piper 425 units valued at $5,684,000 vs. 525 units valued at $7,205,000. Slippage reflects stiffened customer resistance in view of recession, extremely bad winter weather which hurt demonstration programs and a desire to work off excess new and used aircraft inventories. March data should be of interest in watching the trend since this is traditionally a month of a high volume of factory shipments in the business and utility aircraft industry.**
**N.R—No report.**

and all stiffeners and the skins being machined to provide integral stiffening. Upper 12 in. of the vertical fin are of reinforced plastic to enclose communications antennas.

Fuselage is built up of ring-type frames fabricated from extruded sections, hydro-pressed sheet metal sections or machined sections containing integral stiffening. Pressure bulkheads are one-piece, all-machined sections with integral stiffeners and fittings. Fuselage assemblies will comprise a top panel, two side panels and a belly sled section, and will be production engineered to permit automatic riveting processes to maintain uniformity and maximum quality fastening.

Fuselage skins in pressurized area are additionally stiffened by use of bonded or riveted doublers in door and window cutout areas, across the frame and in longitudinal member areas to provide fail-safe crack-stopping protection.

Cabin layout will provide four seats, two on each side of the aisle, in a standard configuration – although another layout is possible, providing a four-seat couch, plus two standard seats. Cabin area is roomy, providing adequate leg room. Entrance door is on the left side of the fuselage, forward of the cabin, separating the passenger area from the cockpit. Entrance area provides room for a lavatory and provision is made for using the area for food and beverage storage. Doors close off both the cabin from the entrance (lavatory) service area and the cockpit from this area.

Cabin entry door, measuring approximately 24-in. x 52-in., is of the plug type and is loaded against retention members in the fuselage when the cabin is under pressure. It is first pushed inward to open, then swung out toward the nose. Thick cross section is utilized to house beverage service items.

Roomy cockpit has dual-control provision, and has a large wrap-around windshield providing excellent vision in a wide sector. Seats are adjustable up and down, forward and rearward. Instrumentation layout puts flight groups in front of the pilots, engine group in the center of the panel. A center pedestal between the seats contains engine controls, communications equipment controls and trim tab controls. A landing gear control wheel is on the left side of the cockpit.

A master warning light panel is fitted on the instrument panel, indicating these items: fuel quantity (low), oil pressure, fuel pressure, duct ice, cabin

## Jet Commander Performance

| | |
|---|---|
| Cruise speed (20,000 ft. and above) | Mach 0.8 |
| Cruise speed (under 20,000) | 415 mph. |
| Stall speed (clean) | 111 mph. |
| Stall speed (landing configuration) | 95 mph. |
| Maneuvering speed | 234 mph. |
| Never exceed speed at sea level | 477 mph. |
| Max. landing gear down speed | 287 mph. |
| Max. flap extension speed | 172 mph. |

door integrity, cabin pressure and gyros.

Landing gear system is designed so that by actuating a lever located on the center pedestal, the main gear only can be lowered to aid in braking at any speed up to 250 kt. true airspeed. System is laid out so that should the nose gear require lowering, to complete gear down procedure, the lever on the pedestal need not be activated. All the pilot has to do is push the normal landing gear lever down on the panel and the cycle is completed with the main gear lever automatically returning to "off."

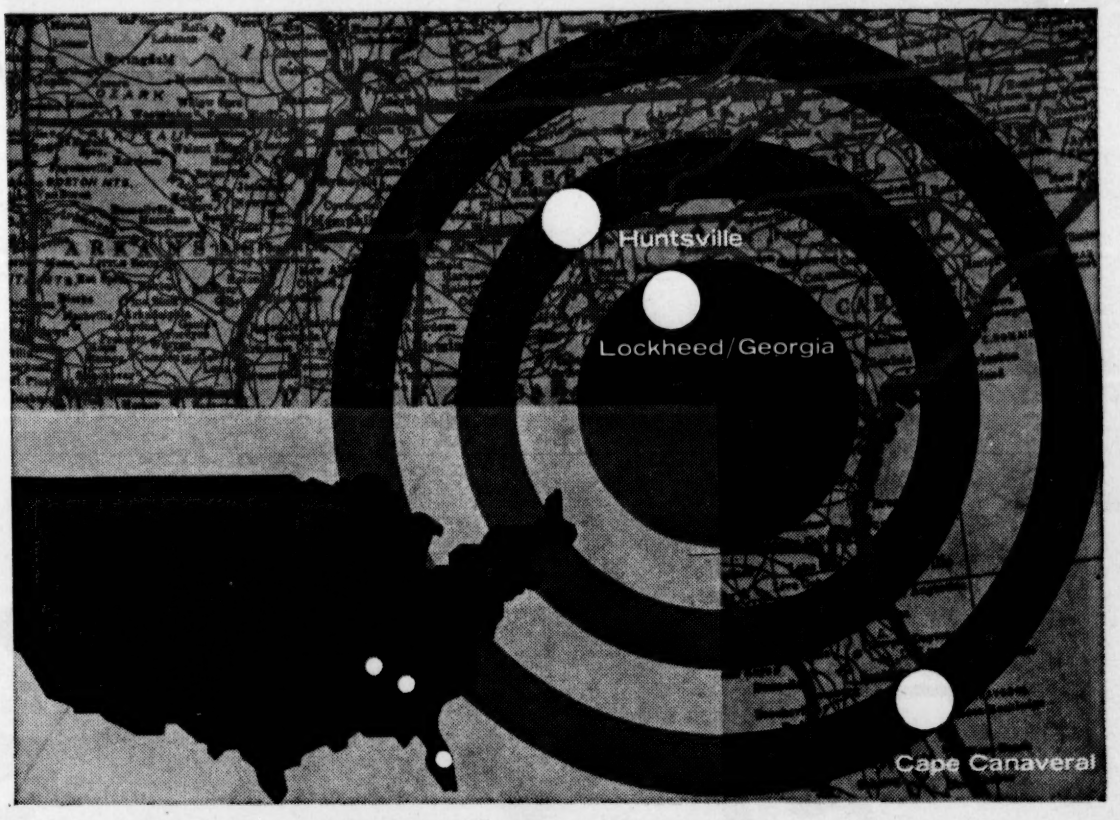
Cabin pressurization system is of the automatic type, operated by the man in the left seat who sets in altitude to be used and rate of climb program. After engines are started he presses a button to activate the system and it automatically handles pressurization requirements. Cabin pressurization is furnished by dual air-driven compressors, either one of which will supply sufficient capacity to maintain normal operating cabin pressure of 7.5 psi., equivalent to 8,000 ft. altitude, when the airplane is at 32,250 ft.

Pilot and passenger cabins are fitted with separate emergency oxygen systems, with masks in the cabin falling down automatically from over-head installations. Cabin has seven 14-in. x 15-in. triple-piece windows, four on the right side, three on the left.

High-pressure, demand oxygen system provides a duration of 30 min. at 35,000 ft. for the pilots and 30 min. for each of four passengers at this altitude.

Instrument panel lighting is the indirect type consisting of a group of small red and white bulbs intermixed with ratio of one white to eight red along the lower edge of the panel. Lighting can be varied in intensity, for all-white, all-red or mixed red-and-white as the pilot wishes.

Standard communication equipment will include two transmitters and two receivers. Navigation system will be a dual set-up, with two VHF receivers, a marker beacon receiver and two glide slope receivers. Sperry SP-3 autopilot with integrated altitude and approach


**STRATEGIC AEROSPACE CENTER** ■ Lockheed/Georgia is next door to Huntsville and Cape Canaveral. This strategic geographic location eliminates excessive transportation costs, makes technical liaison more efficient, and reduces the overall time span of aerospace programs. And the Georgia Division is big enough physically to handle any program yet conceived—big enough in capability to take on the full gamut of advanced research and manufacturing jobs. **LOCKHEED/GEORGIA**
MARIETTA, GEORGIA


## PROBLEMATICAL RECREATIONS 65

Assuming that each packet of cigarettes from a certain manufacturer contains, as a premium, one of a set of 52 playing cards, and that these cards are distributed among the packets at random (the number of packets available being infinite), what is the average minimum number of packets that must be purchased in order to obtain a complete set of cards?

— *American Mathematical Monthly*

Re-cap of the complete picture at Litton Industries: 27 plants and laboratories, over 40 foreign subsidiaries, more than 1,500 sales and service branches in 93 countries throughout the Free World. Our business: Defense Equipment and Systems, Business Machines, Communications, Components, Geophysical Research and Instrumentation.

ANSWER TO LAST WEEK'S PROBLEM: Since every integer has a unique decimal representation, every non-negative integral power of X will appear exactly once in the product. Hence the product equals $\sum_{n=0}^{\infty} x^n = 1/(1-x)$.


**LITTON INDUSTRIES, INC.**
Beverly Hills, California

Monsanto

**Space-Age Project "NEW MOLECULES"**

# CHEMICAL EXPEDITIONS BY

**Beech B95A Travel Air's Base Price Is $49,500**

**Beech Aircraft Corp.'s new Travel Air has a basic list price of $49,500. Powerplants are 180-hp. Lycoming IO-360-B1A fuel injection engines; cruise speed at 75% power is 200 mph. Maximum speed is 210 mph. Range with reserve, based on 195 mph. at 65% power, is 1,035 mi. Gross weight is 4,200 lb., empty weight 2,555 lb., useful load 1,645 lb. Plane seats up to five people.**

control is planned. Radar will be an X-band 18-in. receiver, with a five-inch scope on the panel.

All-weather systems will include electrically energized rubber boots on wings and tail, with engine anti-iced by using bleed air from the CJ-610.

Electrical system is primarily 28-v. d. c. supplemented with 115-v.-400-cycle a. c. to handle the aircraft system, anti-icing, navigation and communications, radar and autopilot. The a. c. and d. c. systems are independent. Hydraulic system utilizes Skydrol or equivalent fluids, with normal system pressures of 1,500-3,000 psi.

Flight control system is a completely conventional mechanical type, with no boost systems employed. Connection from rudder pedals and control column to the surfaces is via push-pull members, bellcranks, pulley and cable systems.

There is a 20-in. x 26-in. baggage compartment door in the lower fuselage behind the cabin. Area is unpressurized, but Aero Commander is studying pressurization in the event there is a demand for it. There is also an access door in the bottom of the aft fuselage behind the baggage compartment, measuring 21-in. x 30-in., providing standup access to a compartment housing all electronic black boxes, pressurization equipment and accessories.

Landing gear has twin wheels fitted on the nose gear, single wheels on cantilever struts on the main gear. All oleo struts have a maximum operating travel of 8 in. Nose gear wheels and tires are 16 in. x 4.4 in. and can be power steered through 45-deg. each side of center. Wheels retract aft. Main gear, consisting of 24-in. x 7.7-in. Goodyear wheels, tires and brakes are the same wheels and brakes used on the Grumman Mohawk. Landing gear struts are by Electrol.

## MS-880 Production Rate to Be Doubled

**Paris**—Continued sales success of Morane-Saulnier's all-metal MS-880 Rallye has led the French builder to double planned production rate.

Company expects to reach a monthly production rate of 30 this summer and to double this rate by March of next year.

To date, company has received 311 firm orders for its three-place sports plane. Coleton Aircraft Corp., Muskegon, Mich., plans to assemble the Rallye in the U. S. (AW Mar. 20, '61, p. 96).

Single-engine Rallye is offered in three powered versions ranging from 90 to 145-hp. Continental engines.

U. S. price ranges from $5,750 for the 90-hp. version to $7,995 for the 145-hp. aircraft. Latter, designated MS-885, has just begun its test flights. MS-885 prototype will be shipped to U. S. for demonstration on May 15.

## Beech 1961 Military Business Declines

Sharp tapering off in military business is reflected in Beech Aircraft Corp.'s first six month's annual report, which notes total sales of $36,799,770 for this period of the company's Fiscal 1961 year, compared with $52,199,150 for the same period last year. Net earnings, after taxes for the six months just ended totaled $1,352,200 compared with $2,459,545 for the same period in Fiscal 1960.

Sales breakdown for the first six months of Fiscal 1961, with comparable 1960 figures in parentheses—military sales, $13,599,489 ($29,215,818) and business aircraft sales, $23,200,281 ($22,983,332). Indications that consumer resistance, occasioned by the U. S. industrial recession, applied some braking to business aircraft sales despite increased sales efforts were evident in the company's conservative statement that ". . . our complete line of Beechcraft business planes are finding a steady market," rather than emphasizing any of the major percentage increases that have been common in this area over the past year.

Export sales showed a gain of 71% over the same period in Fiscal 1960.

The company declared its regular 15 cents quarterly dividend for each of the 2,703,013 shares outstanding, payable May 3 to holders of record on Apr. 21.

# Skywagon Designed for Multiple Missions

By Andy Keil

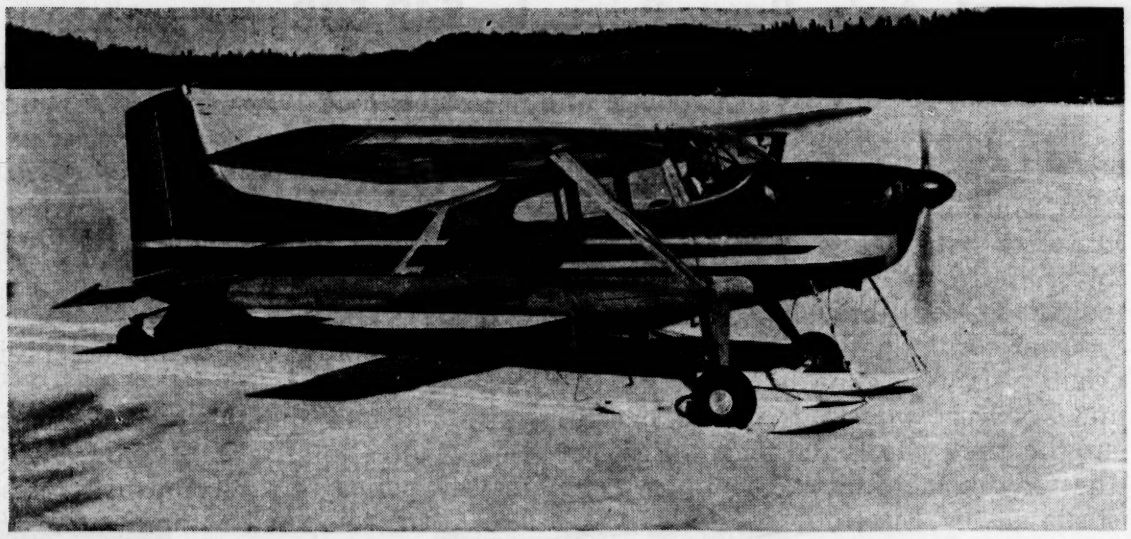
Cessna Aircraft Co.'s combination of a 260-hp. fuel-injection engine, an 88-in. constant speed propeller and an all-new spacious airframe gives its 185 Skywagon the 'work-horse' potential for which it was designed.

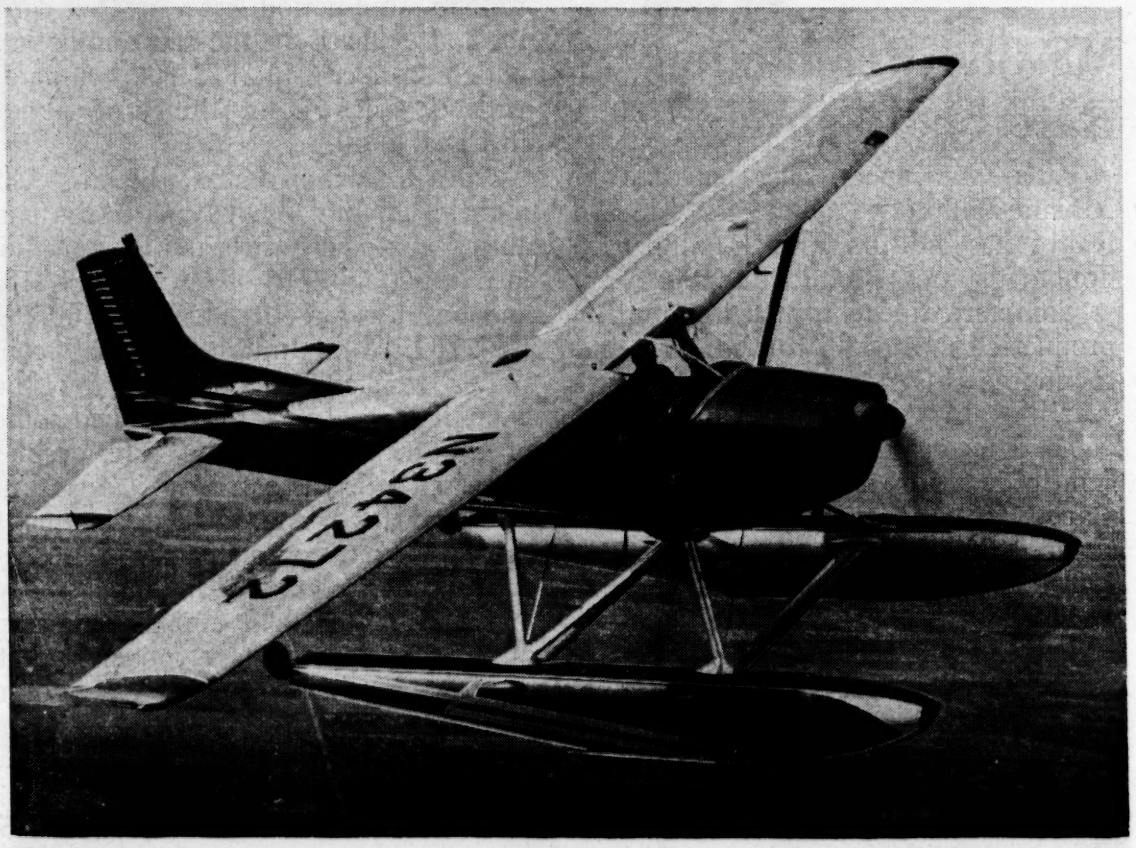
Powered by the Continental IO-470-F engine, Cessna's latest all-metal high-wing aircraft carries six adults and 270 lb. of baggage with full standard fuel of 65 gal. at speeds up to 176 mph. Equipped with floats, the Skywagon will carry five adults and full standard fuel up to 150 mph.

Attachment of a 37-lb., 9 ft. x 31-in. plastic pod to the underside of the fuselage affords an additional 12.5 cu. ft. of storage area with a penalty of less than 6 mph. and no alteration in take-off and landing configuration.

The Skywagon, priced at $18,950 fly-away at the factory, is similar in configuration to the Cessna 180 with the exception of the third window which gives the fuselage a longer appearance and provides visibility for the passengers in the third row of seats.

Walk-around inspection shows the principal dimensions to be 25 ft. 6 in. from propeller hub to tail wheel, which extends a fraction beyond the rudder. Wing span is 36 ft.; elevator span 10 ft. 10 in. with the rudder reaching to a height of 7 ft. 9 in. Height of aircraft floor at cabin entrance is 33 in. with outside entrance to baggage compartment 28 in. above the ground. Wheel span is 7 ft. 8 in.





**SKYWAGON will also be certificated for float plane operations early in May to meet expanded mission and performance requirements. Equipped with skis the aircraft is shown operating in the snow at top**

Model flown was a stripped-down version without radio equipment, gyro compass, needle and ball, rate of climb or outside-air temperature instruments. Empty weight of this particular aircraft with seaplane fittings attached was 1,658 lb., grossing out to 2,410 lb. on the evaluation flight. Serial numbered N9820X, it was the 21st production model off the Skywagon line with a total of 15.29 flying hours accumulated.

Entry to the aircraft is via either right or left cabin door which are 37 in. wide and 41 in. high at their maximum dimensions. The right cabin door has removable hinge pins and a detachable door stop permitting door removal when large or bulky cargo must be loaded.

Sliding pilot and copilot seats facilitate entrance to the second row of seats. The back-rest of the center seats can be folded forward or removed to gain access to the rear double seat. Five different loading configurations are possible within the spacious cabin as all but the pilot's seat are easily removable.

The cabin is roomy and comfortable with no restriction to individual movement. Excellent vision is provided by large windshield and side windows. A large hinged window on the pilot's side aids ground ventilation. Two ventilators, one in each upper corner of the windshield and two additional ball and socket ventilators provide additional cabin ventilation when airborne.

Instrument panel follows the standard Cessna policy of grouping flight and navigation instruments on the left-hand panel with radio equipment, manifold pressure, rpm. and fuel flow gages in center panel. Right-hand panel contains space for additional radio navigation equipment and engine instruments.

Vernier throttle, propeller and mixture controls protrude below the center panel along with the cowl flap lever which is to the extreme right of the center panel.

## Fuel Pump Toggle

Auxiliary electric fuel pump toggle, cabin heat control and generator occupy a space above the throttle and propeller controls with the master switch, combination starter/ignition key and auxiliary switches covering the lower panel along with the circuit breakers.

Recommended 100/130 octane fuel is located in two tanks, one in each wing, holding 32.5 gal. each. Total

**SKYWAGON** is powered by 260 hp. Continental IO-470-F engine and cruises up to 176 mph. with a full load.

usable fuel of 31 gal. each is gravity fed from outlets in front and rear bottom of each tank to a fuel accumulator tank. Flow from each tank is simultaneously equalized with no cross-feed arrangement. A gas shut-off valve and fuel strainer is inserted between the fuel accumulator tank and engine-driven fuel pump, by-passing two electric fuel pumps when they are not operating. The pressurized fuel from the fuel pump flows through a fuel control unit to a distributor manifold which disperses the fuel to a fuel nozzle on each engine cylinder.

Vapor and excess fuel from the engine-driven fuel pump and fuel control unit are returned to the main fuel tanks by way of a vapor separator-fuel accumulator tank.

The fuel flow dial indicating the approximate gallons per hour of fuel being metered to the engine is segmented into arcs indicating proper fuel flow for various throttle settings to aid in leaning the mixture for desired power. The indicator has cruise power settings on its low-flow portion and takeoff and climb settings for various altitudes on its high-flow portion. The takeoff and climb markings represent maximum-performance mixtures for the altitudes shown, making it practical to lean the mixture on a high-altitude takeoff and during a climb.

Turning the combination starter/ignition key to the 'Start' position cuts out the right magneto, supplying a shower of high-voltage, retarded sparks from a starting vibrator used in conjunction with the left magneto. The Continental fuel-injected engine fired immediately and pressure was released on the starting key which returned it to the 'Both' position providing dual ignition for better engine acceleration.

A standard takeoff and climbout was initiated with full throttle and rpm. of 2,625, with a slight degree of rudder control to overcome torque as the Skywagon started its takeoff roll.

## Short Takeoff Roll

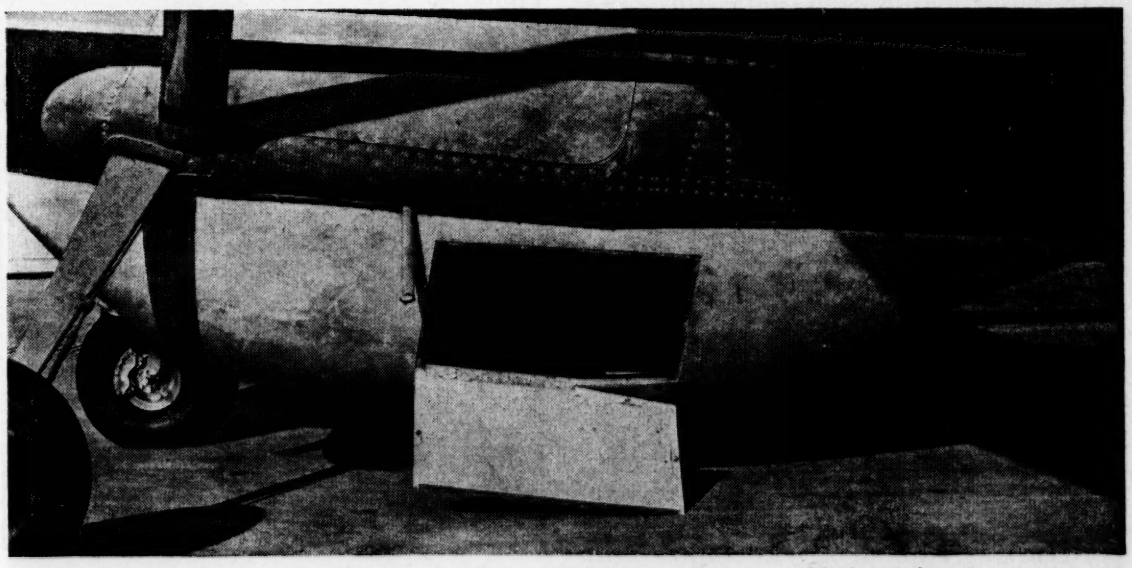
With an indication of 65 mph., back pressure was applied to the control column and the aircraft broke the runway with a ground roll of approximately 350 ft. When normal climb speed of 110 mph. was established, power was reduced to 24 in. and 2,450 rpm., mixture was leaned to 15 gph. fuel flow, cowl flaps were opened to one-half and a climb to 4,000 ft. was accomplished.

With the needle/ball and gyro compass instruments absent, climbing turns and headings were maintained by magnetic compass. However, the stability of the Skywagon was such as to allow 'hands-off' flying in climb, climbing-turns and straight and level with adjustment of throttle, elevator and aileron trim.

At 4,000 ft. with cruise power setting of 23 in. and 2,300 rpm. (65% bhp.) and mixture leaned to 12-plus gph., the indicated airspeed was 160 mph.

Reducing manifold pressure to 12 in. and full rich mixture, aircraft was flown in steep turns, as well as straight and level. At an indicated airspeed of 70 mph., aileron and rudder controls were positive and firm without sluggish response.

Cutting the power completely, the aircraft was held in the straight and level attitude until it stalled at the speed of 45 mph. As the airspeed approached 55 mph. the warning horn sounded, varying in pitch and wavering as it approached the stall speed. The stall was clean and gentle without a wing-dropping tendency. The nose fell



**PLASTIC POD,** 9 ft. x 31 in. and weighing 37 lb., provides extra 12.5 cu. ft. of storage area with a penalty of less than 6 mph. and no change in takeoff or landing configuration.

## Skywagon Performance

Gross Weight .....3,200 lb.
Speed, best power mixture
  Maximum at sea level.....176 mph.
  Maximum recommended cruise,
    70% power at 8,000 ft...165 mph.
Range, normal lean mixture:
  Maximum recommended cruise,
    70% power at 8,000 ft.
    62 gal., no reserve.....770 mi.
      4.7 hr./164 mph.
    81 gal. no reserve
    (long-range fuel tanks)...1,005 mi.
      6.1 hr./164 mph.
  Maximum range at 10,000 ft.
    62 gal., no reserve.....945 mi.
      7.1 hr./133 mph.
    81 gal, no reserve
    (long-range fuel tanks)...1,235 mi.
      9.3 hr./133 mph.
Rate of climb, sea level.....1,000 fpm.
Service ceiling .....17,300 ft.
Takeoff:
  Ground run .....950 ft.
  Total distance over 50-ft. obstacle .....1,510 ft.
Landing:
  Landing roll .....470 ft.
  Total distance over 50-ft. obstacle .....1,270 ft.
Empty weight (approximate)..1,550 lb.
Power: Continental 6-cylinder engine .....Fuel Injection
      IO-470-F
      260 hp. at 2,625 rpm.
Propeller: McCauley Constant Speed
      D2A36033/90M-2

through the horizon, picked up airspeed and the aircraft was flying again.

With the nose of the aircraft 45 deg. above the horizon, another power-off stall was made—again with no violent action.

With full flaps applied, the nose was again pulled up 45 deg. above the horizon. In this flap configuration, the needle passed below the lowest indication of 40 mph. on the airspeed indicator before the aircraft stopped flying.

It is estimated that with the nose high and full flaps this stripped-down Skywagon stalled at approximately 30 to 35 mph. There was little loss of altitude with standard recovery procedures. Good aileron control was apparent at all times and in all stall configurations.

In a rate of descent demonstration, full flaps were again applied and power cut completely. When 110 mph. was attained, the aircraft was stood on its nose and we descended approximately 2,000 fpm. at a continued 110 mph. without buffeting or strain.

Coming in for the landing, the traffic pattern was entered at 110 mph. Ten degrees of flap were dropped on each pattern leg and the aircraft was slowed down by power reduction until we were flying at 85 mph. and full flaps over the fence. Cutting power over the runway and applying back pressure on the controls, the aircraft rounded out nicely and settled in a three-point landing.

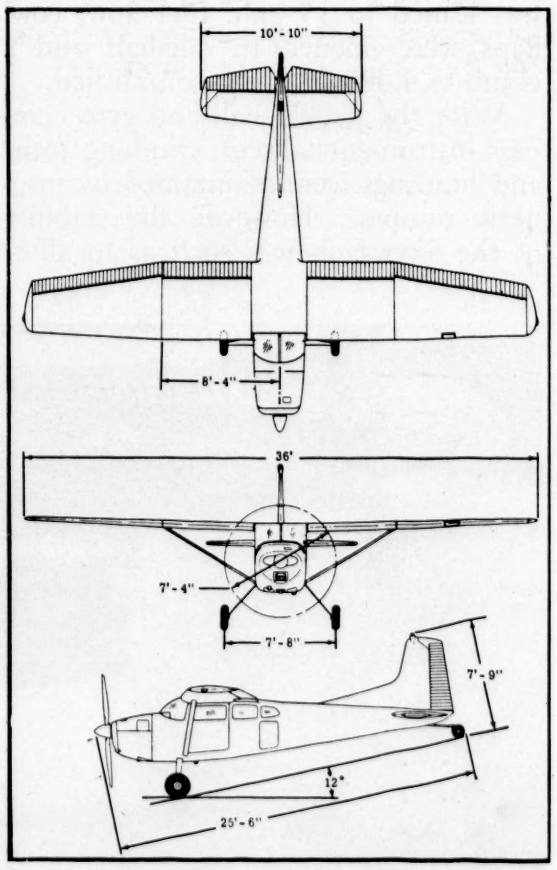
Flying the pattern again and applying the same techniques with different flap configurations produced the same results. The slow stall speeds and stable flying characteristics of the Skywagon combine to make it an easy aircraft to land.

The only possibility of difficulty that can be conceived dwells with the narrower span of the landing gear of high-wing aircraft in comparison with that of low-wing aircraft. A pilot accustomed to low-wing aircraft not cautious of this fact could find himself in difficulty but he would find the steerable tail wheel on the Skywagon a great assistance.

In a 'short-field' takeoff demonstration, brakes were held while 10 deg. of flap were lowered and full throttle applied. When brakes were released the aircraft was kept in a tail-low attitude and after approximately 250 ft. of ground roll, with stall warning horn sounding, the plane left the ground at an indicated 45/50 mph.

Designed in response to what Cessna said was a demand for expanded mission and performance requirements, particularly for heavier payloads than those carried by the Cessna 180, the utility Skywagon will also be certificated for float plane operations in early May.

Present production schedules call for delivery of 93 Skywagons by May 8, 1961.




**THREE-VIEW** diagram above shows principal dimensions of the Cessna Skywagon.

# PRIVATE LINES

**Piper delivered 308** business and utility aircraft in March for a total factory billing value of $3,452,477, bringing cumulative number of planes it has delivered in the first quarter of 1961 to 733 having a total factory billing of $9,136,815. March model breakdown—13 PA-18-A Super Cubs, 169 Colts, 3 PA-22 Tri-Pacers, 9 PA-23 Apaches, 21 PA-23 Aztecs, 20 PA-24 Comanche 180s, 54 PA-24 Comanche 250s and 19 PA-25 Pawnees. Delivery of "economy-model" two-place Colt totals 335 units for three-month period.

**Grumman Gulfstream** JATO units installed by Mattituck Airbase Corp., Linden, N. J. provide 1,000 lb. of emergency thrust per unit for 15 sec. Installation at the wing fillets center the thrust and provide minimum yaw conditions at a cost of $8,950 and can be installed in 10 days.

**Beech Aircraft Corp.** will certify qualified distributor mechanics as either "master mechanics" or "specialist technicians." To qualify, an applicant must hold applicable Federal Aviation Agency license; serve a minimum of five years at a Beechcraft certified facility; attend factory training schools and pass a written examination covering all models of Beechcraft airplanes.

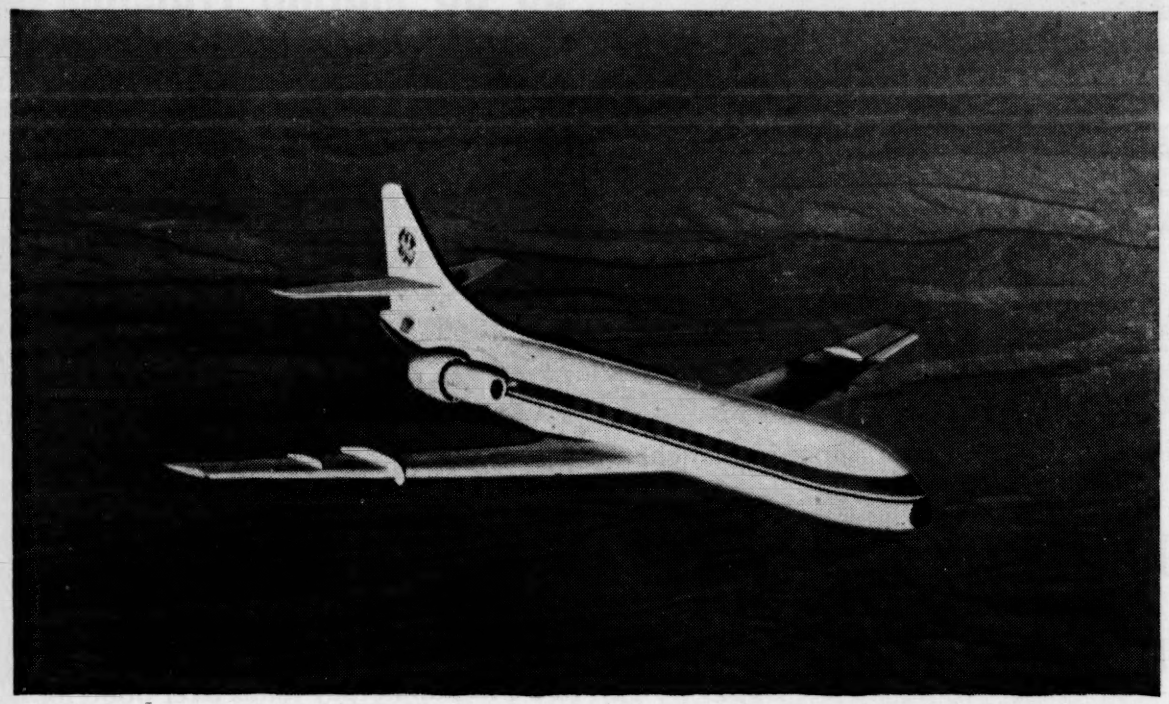
**Rick Helicopters,** San Francisco, will use a reconditioned Boeing Vertol 44 19-passenger helicopter with flotation gear as an air ferry on an Alaskan pipeline project. Line is being laid between Kenai Peninsula and Anchorage, Alaska. Helicopter will transport 18 crewmen, and will make eight trips daily between Kenai and a barge anchored in Turnagain Arm.

**Aircooled Motors, Inc.,** wholly-owned subsidiary of Tucker Corp., is being offered for sale. Aircooled manufactured the Franklin aircraft engine, including the turbosupercharged 6VS-335 which powers the Bell 47-G helicopter. The company's assets include a 130,000-sq.-ft. manufacturing plant on 12 acres of land; general purpose machinery and other plant equipment; spares inventories and tooling for Franklin engines, and manufacturing rights to all Aircooled Motors engines, including drawings and engineering data.

**Grumman Ag-Cat** spray/dust aircraft's gross weight can be increased to 3,750 lb. by installation of the FAA-certificated 240-hp. Gulf Coast W-670-240 engine produced by Gulf Coast Dusting Co., Houston, Tex.

Flight Propulsion NEWS

# G-E Paris Air Show Theme: Aviation/Space Progress



## G-E CARAVELLE NOISE LEVELS ARE QUIETER BY SIGNIFICANT MARGIN

EDWARDS AFB, Calif.—Preliminary noise tests on the General Electric Caravelle have indicated its G-E CJ-805-23 aft-fan engines reduce interior speech interference levels (S.I.L.) by an average of about seven decibels.

Test results, which were based on measurements made by Douglas Aircraft Company, showed passenger compartment S.I.L. ranges are reduced as much as 11 db.

Speech interference level, considered the most important of interior noise measurements, is the average of the readings in the three octave frequency bands between 600 and 4800 cps. Conversation can be understood if the S.I.L. is equal to the level of speech.

In the Caravelle tests, 80 percent of the passenger compartment measurements fell below the normal voice levels of passengers sitting one foot apart. At raised voice levels not one voice level condition was above S.I.L. measured. All internal measurements were taken at the window seat position.

External noise measurements on the Caravelle show that it is by far the quietest jetliner flying. For example, at normal gross weights with full take-off power, noise levels on the ground under the flight path 8500 feet from start of take-off roll are less than 112 PNdbs.

G.E.'s aft-fan-equipped Caravelle is now in its fifth month of intensive flight test at Edwards AFB, Calif. Performance and test results to date have proven highly favorable.

***See the CJ-805-23 at the Paris Air Show***

## T64 Grumman Gulfstream Program Announced

BETHPAGE, N. Y.—An active development program for installation of General Electric T64 turboprop engines on the Grumman Gulfstream has been announced by Grumman Aircraft Engineering Corporation.

The Gulfstream, now in service in the United States and throughout the world, is the first twin-turboprop aircraft in its size category designed specifically for corporate use.

In a similar development program, engine installation work on the T64-powered deHavilland Caribou is nearing completion. A nine-month flight test program is scheduled for early this summer.

Other installation studies of T64 turboshaft/turboprop configurations are underway by a number of airframe companies proposing the T64 for VTOL aircraft. General Electric's 2850 shp T64 engine offers a very attractive power-to-weight ratio. It has a low specific fuel consumption, which is maintained throughout the operating range of the engine.

A designed-in ability to operate continuously at attitudes from 100 degrees above the horizontal to 45 degrees below makes it highly adaptable to VTOL/STOL applications.

**General Electric's T64 turboprop engine will be among those on display at the Paris Show**

## Latest Propulsion Hardware Will Be On Public Display

PARIS, France—General Electric's Paris Air Show exhibits will place on public display the wide spectrum of the Company's aerospace achievements.

The General Electric stand will also feature a large array of G-E aviation and missile hardware, ranging from the Discoverer capsule to constant speed drives and cockpit instruments.

The J79 engine, G.E.'s Mach 2 turbojet that has powered four U.S. aircraft (Lockheed F-104, Convair B-58, North American A3J, McDonnell F4H) to 18 world speed and altitude records, will be shown in an exploded-display fashion. Another exhibit will feature the 3850 lb thrust class J85, which currently powers Northrop's T-38 supersonic trainer and N-156F fighter.

A large rotating exhibit will display the basic J79/CJ-805 gas generator in conjunction with its major components. These include afterburner, commercial sound suppressor and thrust reverser, the G-E aft turbofan, and a power turbine and exhaust system that converts the engine to turboshaft power for marine and industrial use.

The CJ-805-23 turbojet, G.E.'s commercial aft-fan engine now powering the Convair 990 and the Sud Caravelle VII, will be shown in full-scale cutaway. Full-size models of the smaller CJ610 and its aft-fan equivalent—the CF700—will also be included.

Turboshaft engines on display will include the T58 and T64 powerplants. Both are under active consideration in Europe as turbocopter drives.

Other displays will include hydraulic constant speed drives, and an exhibit of the several approaches to VTOL/STOL lift currently under development at General Electric.

Flight Propulsion NEWS

Sleek, supersonic T-38s will school USAF pilots in the rigors of space-age flight

# T-38 Supersonic Trainer Enters Service; Will School USAF Pilots by Year's End

RANDOLPH AFB, Tex.—A new era in supersonic flight training began in mid-March here with delivery of the Air Force's first operational T-38s.

For the two-place Northrop jet, this was the last step prior to entering full-fledged service as a "supersonic classroom" for space age pilots. The T-38 will provide new dimensions in safety and versatility to pilots training in the art of supersonic flight.

According to Air Training Command schedules, the aircraft will be used for instructor familiarization and check-out here until early fall. Then it will transfer to Webb AFB, Texas, and fully operational training status.

The T-38 "Talon"—powered by twin General Electric J85-5 turbojets—is the world's first supersonic aircraft designed expressly for training purposes. It combines performance capabilities of jet fighters twice its size with the highest safety assurance of any aircraft in its performance class.

The new trainer has Mach 1.2 speed capabilities, and a maximum rate-of-climb of 30,000 fpm. A single-place counterpart of the T-38, Northrop's N-156F "Freedom Fighter," has somewhat greater performance capabilities.

*See the J85 engine at the Paris Air Show*

# Vertol Copter Selected as US Marine Transport

WASHINGTON, D. C.—A military version of the Boeing-Vertol 107 turbine-powered helicopter has been selected as assault-transport for the U.S. Marine Corps.

Like the 107-II, the military Vertol craft will be powered by two General Electric T58-8 gas turbine engines.

The Vertol 107 prototype design originated as a 1700 hp turbocopter. Two of these ships have been uprated to 2300 hp and are now undergoing FAA certification tests. The 25-passenger commercial 107-II will enter service this year with New York Airways.

Primary innovation in the Marine Corps version will be power-operated folding rotors, making the transport adaptable to the limited elevator and hanger dimensions of Naval assault ships. It will be fitted with 26 seats, and will handle pay loads over 5000 lb.

The G-E T58 engines, which will provide the turbocopter with 120 mph cruising speed and 145 mph top speed, have already proven their reliability in over 50,000 hours of operation.

G-E T58 engines also power the U.S. Navy's Sikorsky HSS-2 helicopter and its commercial version—the S-61, Kaman's HU2K, and the FAA certificated Sikorsky S-62.

*See the T58 engine at the Paris Air Show*

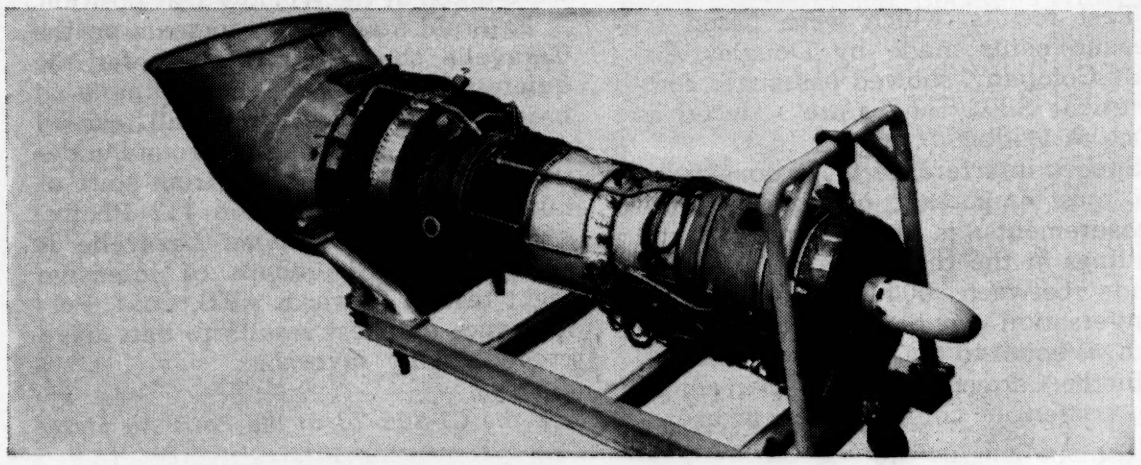
# 2905 MPH HIT BX X-15; TOP MANNED SPEED MARK

EDWARDS AFB, Calif.—The X-15 rocket plane streaked to a new manned-flight speed mark of 2905 mph on March 7 here.

The experimental aircraft, whose mission will soon carry it to the fringes of space at speeds up to 4000 mph, made its run at 75,000 feet.

Power for the X-15's electrical and hydraulic systems was supplied by two General Electric auxiliary power units, unique turbodrives that operate independently of the aircraft's rocket engine. The hydrogen peroxide powered APU's assure aircraft control and pilot safety.

*See General Electric's constant speed drives at the Paris Air Show.*



# Model 240 Marine Turboshaft on Test

CINCINNATI, Ohio—General Electric's Model 240 turboshaft engine is now undergoing qualification test prior to application on the U.S. Maritime Administration's 80-ton, 60-knot hydrofoil craft scheduled for sea trials this summer. The engine is part of a marine power package offered by G.E. that includes powerplant, transmission, and docking engine.

A modified turboshaft version of General Electric's proven CJ-805 commercial turbojet, the basic Model 240 engine weighs 6600 pounds, only one-tenth as much as similarly rated reciprocating engines and steam propulsion systems. Its compact size makes it suitable for displacement ship propulsion, and use as a mobile electric power unit.

Besides size and weight advantages, the Model 240 is expected to offer sizeable benefits in maintenance simplicity. The G-E powerplant consists of a CJ-805 turbojet engine coupled aerodynamically to a newly designed power turbine that converts jet thrust to turboshaft horsepower.

High speed hydrofoil vessels are expected to play an important role in the future of marine transportation. Planned future versions will carry hundreds of passengers at 80-knot speeds.

*See the Model 240 engine at the Paris Air Show*

**End of the 257th test mission: the F-104/J79 hits 500 hours without major overhaul**

# F-104 ACHIEVES 500 FLIGHT HOURS WITHOUT MAJOR ENGINE OVERHAUL

TINKER AFB, Okla.—The Lockheed F-104/J79 weapon system has shown that it can achieve 500 flight hours without a major engine overhaul.

Capability of the "Starfighter's" J79-GE-7 engine to reach the 500-hour mark was proven by a USAF accelerated service test mission terminated during March, 1961.

The program was conducted over a six-month period, and involved 257 typical Tactical Air Command missions. It was jointly managed by the U. S. Air Force's Oklahoma City Air Materiel Area Maintenance Division, and the General Electric Company.

In the U.S. Air Force and the Air National Guard, F-104/J79 effectiveness has been measured by daily use. Better than 98 percent of over 35,000 flights have been reported trouble-free.

The J79 engine of the Mach 2 fighter produces nearly 16,000 pounds of thrust, yet weighs less than 3600 pounds. It has powered the F-104 to eight world time-to-climb records, and the world altitude record of 103,395 feet.

***See the J79 engine at the Paris Air Show***

# VTOL Flight by 1963 Slated for G-E Lift Fan

CINCINNATI, Ohio—First flight test of a lift-fan powered VTOL aircraft is planned for 1963 by G.E.'s Flight Propulsion Laboratory Department here.

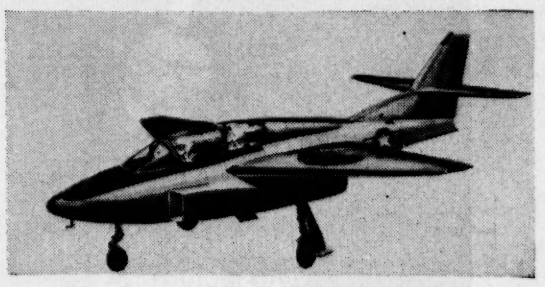
The G-E timetable is based on a proposed flight research test series demonstrating capabilities of the company's J85-powered lift fan for aircraft of the future. Estimates are that a lift-fan powered jet aircraft will be airborne 21 months after start of the program.

Under the proposed G-E plans, an experimental aircraft will be equipped with two wing-mounted lift fans powered by J85 engines installed in the fuselage. Engine thrust will power the fans during takeoff and landing, and will be converted to jet thrust for horizontal flight.

An important VTOL safety factor will be incorporated by cross-ducting each engine's thrust so that equal amounts are delivered to each fan. With this arrangement, 61 percent of the aircraft's design lift can be retained in the event of an engine failure.

General Electric's proposed flight research program will culminate four years of basic lift-fan development and research. A J85-powered lift-fan engine has already completed over 100 hours of successful test-bed and wind tunnel operation.

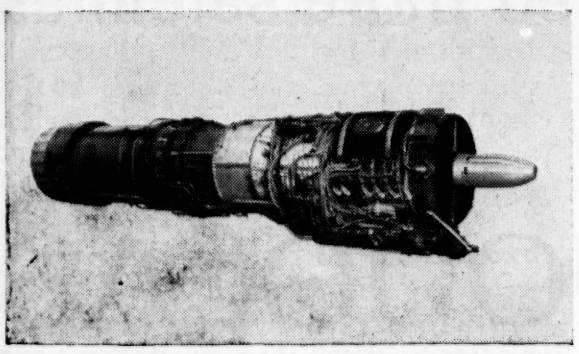
***See the General Electric lift-fan display at the Paris Air Show***

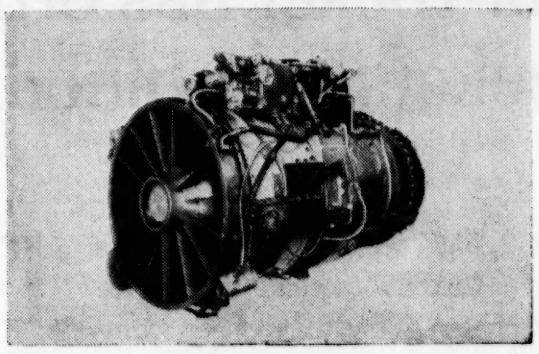


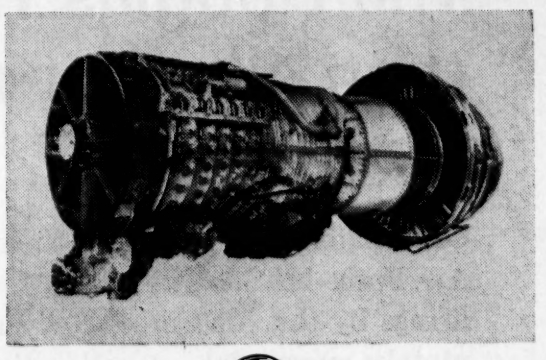
**The lift fan look: one of several airframes considered by G.E. for VTOL testing**

## *See These Engines—and Others—at the Paris Air Show . . .*

**On display at G.E.'s Paris Air Show exhibit will be: *Left*, the J79 16,000-lb-thrust-class powerplant that has powered the Air Force's F-104 and B-58, and the Navy's A3J and F4H to 18 world flight records; *Center*, the J85, recently modified to provide an unequalled 10-to-1 power ratio; and *Right*, the CJ-805-23 aft-fan turbojet, currently powering the Convair 990 and Caravelle VII. Others on display include the CJ610, and CF700 commercial powerplants, and the T58 and T64 turboshaft engines.**

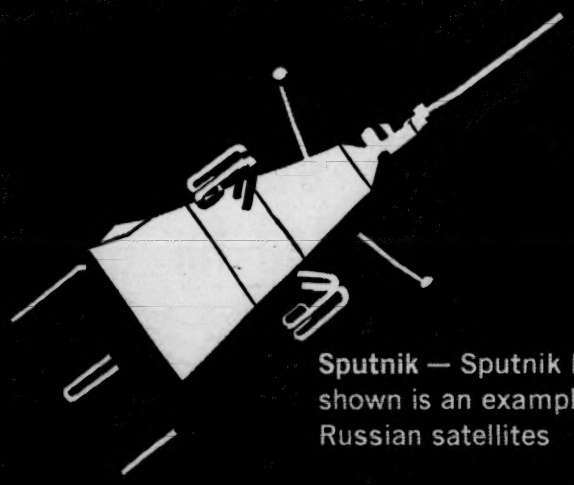






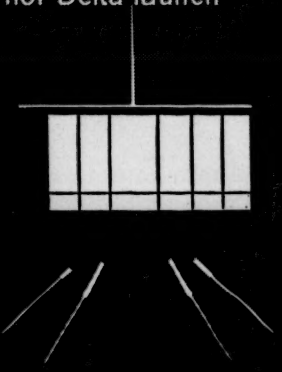
FLIGHT PROPULSION DIVISION

GENERAL ELECTRIC

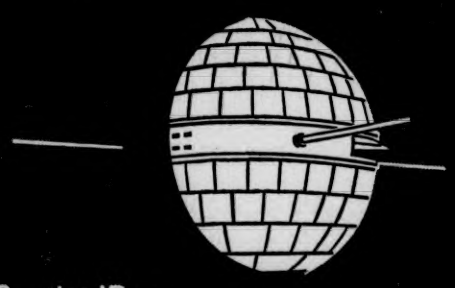


**Sputnik** — Sputnik III shown is an example of Russian satellites

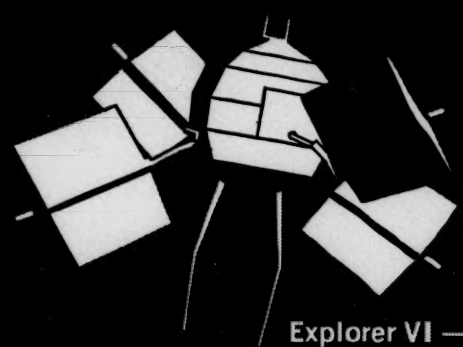
**Tiros I** — Thor-Able launch. Picture-taking weather satellite. Tiros II, also a weather satellite, Thor-Delta launch



**Discoverers** — Fifteen orbited by Thor-Agena to date

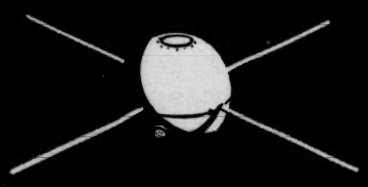


**Courier IB** — Thor-Able Star launch. Active communication satellite

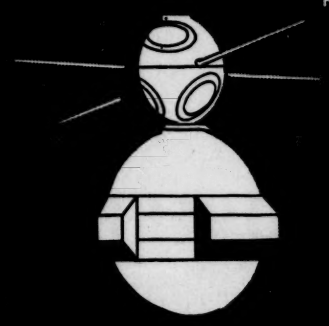


**Explorer VI** — Thor-Able launch. The first paddlewheel satellite

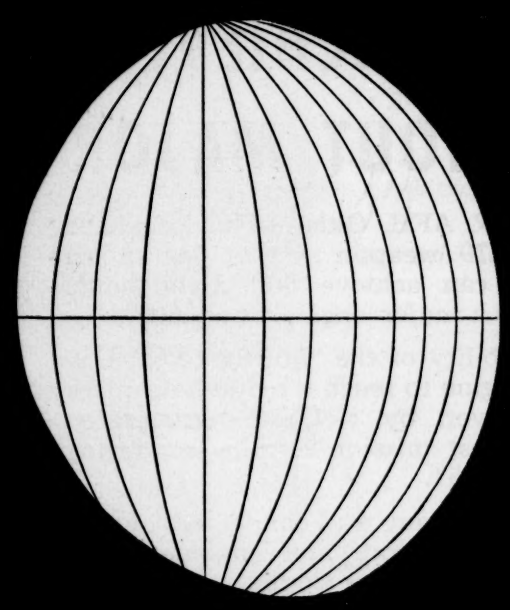
**Transit I-B** — Thor-Able Star launch, the first navigational satellite



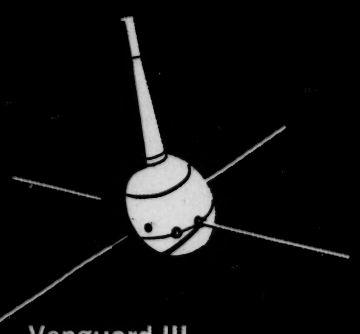
**Vanguard II** — Estimated life 50 years. A test weather-scan concept



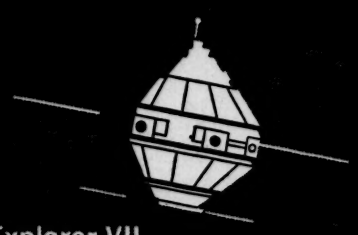
**Transit II-A and Greb** — Thor-Able Star launch. The first piggy-back satellite



**Echo I** — Thor-Delta launch. 100-foot balloon seen by millions. A passive communications satellite



**Vanguard III** — Estimated life 30-40 years. Measures radiation, environment



**Explorer VII** — Launched by Juno II and still transmitting some data

*Above are some of the satellites orbiting the earth, a majority of which were launched by Douglas Thor*

# The Douglas Thor rocket has orbited more satellites than all other rockets combined!

**Of all satellites put in orbit since 1958, 55% were launched by the Air Force-NASA Thor IRBM. In its last 83 tactical and space firings by the Air Force, Navy and NASA, 86% have been completely successful—a reliability inherited from forty years of Douglas experience in aviation and 21 years in missiles and space.**

DOUGLAS

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# New Avionic Offerings Spur Investments

*(Investors in the last two years have shown great willingness to pay high prices for common stocks of relatively young companies in the avionics field on the assumption their future profits would justify high price-earning ratios now.*

*(Loral Electronics Corp., currently selling about 50 times earnings, is a good example of such companies. Its president, Leon Alpert, a lawyer and accountant who was introduced to electronics during World War II when called in by a client to help organize and manage a new company in the field, recently described to the New York Society of Security Analysts how Loral survived the competitive pitfalls in the avionics field and how the company is planning its future growth. Excerpts from the description follow. Later remarks made by Alpert to* AVIATION WEEK *follow in parenthesis.*

Loral was founded about 12 years ago as a small private company with a capital of $50,000, an over-all work force of approximately 12 people which included two engineers, about 14,000 sq. ft. of space and no business contracts of any kind. It was founded on my conviction that the electronics industry was at its threshold, and that one of the greatest industries ever was about to develop.

### First Efforts

Our first efforts were with the military. With limitations in capital, facilities, and technical personnel, we were restricted to the area of greatest competition—namely, open bid contracts.

Up to our Fiscal 1956, we had a good record of constant growth. Due to Korea and other factors, we had sporadic peaks, but our trend was definitely upward.

Post-Korea, and following advent of the new Eisenhower Administration, Secretary of Defense Wilson was faced with a serious problem. He found a confused inventory situation with tremendous accumulations of duplicated supplies and systems. Except for "musts," he ordered a halt in procurement wherever possible. As a result, our backlog suffered in 1955. This resulted in a drop in sales for us and the industry in 1956, but we still showed a good profit. In 1957 we moved into a good sales year. During each of these years we showed good profits. In no year since our existence did we show a loss.

Our post-Korea and 1956 experience impelled us to review our sales philosophy. Prior to that time practically all of our business was under open bid contract against stiff competition. (The company primarily manufactured black boxes to someone else's specifications.)

With increasing competition for this business, sales with profits became more and more difficult. We made a decision. We decided:

- **That military business** was here to stay for a long, long time.
- **The over-all dollar market** in the military would continue to grow.
- **That the only base** on which we could hope to expand in the military would be to expand our technical areas.
- **That to attain** this would require establishing substantial research and development abilities.
- **That we would use research** and development as the means of securing substantial production business, preferably in advanced, specialized areas of least competition.
- **That such research** and development and resulting production would automatically provide future technical fall-offs in non-military areas.
- **That as we were then constituted,** we would not be accepted as a prime research or production facility for advanced complicated systems.
- **That to qualify** for such acceptance the quickest means would be for Loral to successfully complete the research and development of new equipment which would solve an existing problem and need.

### G-2 Operation

We proceeded to establish the beginning of what we called our "G-2" (intelligence gathering) operation. We spent a great deal of time at various government agencies, we looked for an existing weakness in available equipment of importance to tactical operations. In the interests of brevity, let me conclude that we found a "hole." We allocated a quarter of a million dollars of our funds from limited capital and under company-sponsored research and development came up with our ASA-13—a new doppler dead-reckoning airborne navigation computer. Our equipment was more accurate, more automatic and weighed only one-fifth of the equipment it sought to replace. It was basically the first electronic system as against the more mechanical equipment which had been standard up to that time.

(Loral built a prototype of the system in its $250,000 gamble and took it to the potential customer, Navy's Bureau of Aeronautics.

(A research and development contract already had been let to another company for such a system, but Loral was able to impress the Navy sufficiently to win a side-by-side evaluation of both units.)

The net result—our first major contract exceeding $10 million and recognition that Loral was capable of advanced research and development in spite of a limited technical staff. This substantial award made possible the beginning of the expansion of our engineering department and our research and development efforts and has placed us in our present prime position for production contracts of equipment and systems researched and developed by us.

### Personnel Additions

We have taken every business advantage of that result. On a constantly expanding basis we have added to the numbers and the technical scope of our engineering department. From a 1956 total of 94 people, on Mar. 1, 1961 we had 791 in this department.

(Following its 1956 analysis, Loral used its first system contract to gain competence in other specialized technical areas, recognizing that company reputation, ability to perform, and top-notch specialties all were essential ingredients to win further business.

(The company is now divided into division by technological area; Anti-submarine Warfare Division; Countermeasures Division; Display Plotter Division; Missile Technology Division, which includes penetration aids and missile defense systems; Navigational Computers Division; Passive Detection Division, and Reconnaissance Division. Some of its other products include the AN/ASA-25 integrated airborne ASW data processing system; AN/APR-9 countermeasures receiver; AN/ALQ-28 ECM system and the AN/ALQ-53 passive detection system.)

### Sales Network

Where previously Loral handled all sales and liaison from its New York office, today it has offices in Washington, Dayton, Ohio, and Tustin, Calif. From each of these centers we have networks in adjacent important centers of defense activities. On a daily basis, we have field engineers, sales liaison people and research and development specialists in constant personal contact with the engineering, the development, the planning, the tactical and the prob-

lem areas of the Defense Department. Where previously we had one basic customer, namely, Navy Bureau of Aeronautics, today we cover practically every Bureau in the Defense Department including all areas of the Navy, the Air Force, the Army, the Marine Corps and the independent agencies, i.e., National Aeronautics and Space Administration, Federal Aviation Agency and others.

## Daily Reports

Our G-2 daily reports from all liaison contracts are funneled into our home office.

These are sorted into technical and area categories and form the base from which emanate company-sponsored proposals. From these proposals come government-sponsored studies, followed by research and development contracts and in turn production contracts against resulting prototypes. This is a thumbnail sketch of the flow from the beginning of an effort, to research and development contract, to final hardware sale. It is a long road in each instance, but we have reached a point of volume turnover and volume areas which assures us of a constantly growing volume in R&D—and in systems production. And we have reached a point where Loral was listed among the top 100 companies in the country receiving prime contracts for production and among the top 100 companies receiving prime contracts in research and development.

All this has been accomplished since 1956—and I believe the additional statistics in themselves will speak for the results.

In 1956 we employed 430. On Mar. 1, 1961, we employed 2,112.

In 1956 we had 100,000 sq. ft. of facility. Today we have 344,250.

In Fiscal 1960 our sales and profits more than doubled 1959, namely—from $7,996,000 sales and $131,348 net profits, to $17,439,000 in sales and $579,216—net profits. I expect that for Fiscal 1961, ended Mar. 31, we will again more than double sales and net profits over Fiscal 1960.

In management we use every known modern tool under guidance of our own industrial engineering department. This includes constantly reviewed organizational charting with job description and detailed back-up, company standard practice manuals, value engineering, data processing adapted for every possible activity, including cost-as-we-go controls of all contracts, and projection of running contracts. All internal activities for maintenance of our efficiency, all expansions, building activities and administrative procedures are planned and executed by them.

Prior to going public in 1959, Loral was 100% military. As a public company, it became possible to diversify into non-military areas.

In line with our philosophy of acting only after study of all available facts, we organized a new Acquisition Planning Group which proceeded to complete a study of every active area constituting the electronics industry. This comprises at least 106 diversified areas. Many of you have heard of Loral's Product Planning "bible." A careful and thorough analysis was made of each and every one of these areas. This project took six months.

Technical and business committees were organized. Long hours were spent in review. A system of weighing was established. This included consideration of industry background, market and distribution problems, competition, special product considerations, depth of engineering and manufacturing problems and fiscal and business considerations.

In addition, general criteria were established which included consideration of potential profit margins, growth potential, substance and scope of the market, consideration of whether the products served an industrial market rather than a consumer or military market, the need for the products, significance and prestige and enhancement values thereof, entry investment requirements, etc. In addition, consideration was allocated for effect under various political conditions, i.e., garrison state, state of war, and state of peace.

## Slow but Careful

We have moved slowly, but we have moved carefully. To date, we have made two acquisitions, Alpha Wire Corp., and Hillburn Electronics Corp.

Let us look at the Alpha acquisition. We paid a very reasonable price. We acquired a company in business for 39 years. Highest fiscal sales prior to acquisition totaled $2.5 million. Alpha was recognized in the industry as No. 2 in trade brand acceptance. It had 2,120 accounts and a proven sales distribution setup. This sales distribution setup is available for other future products—and is already being used for distribution of our Hillburn Relay Line.

Alpha had approximately 4,000 items in its catalog. It had a high reputation for quality and service. Promptly on acquiring Alpha, we prepared a thorough 4-year expansion plan. We have been adhering to that plan. Among other things, since acquisition, many new items have been added to their line. These include a full line of retractable coil cords, conventional cord sets for power and communication equipment, a full line of shielding and braiding wire which meet government specifications, a line of wrapped teflon wire; additional lines of outdoor wire and cable; a full line of TV wire and cable for the distributors' market; and other items. The West Coast plant which had been opened at about the time of acquisition has been expanded to perform full manufacturing and warehousing functions and is now servicing 13 western states. A market research department has been organized. We entered into a joint venture with a laboratory outstanding in the field of radiation applications to develop irradiated polyolefin wire and cable.

. . . Alpha is doing things on a planned basis to build up its volume. Sales during our first year of operation will show an increase of approximately 40%. The total wire market is sizable, i.e., $200 million.

A few words about Hillburn Electronics Corp.: For a nominal stock consideration, we acquired a small company. It had developed a complete line of high quality industrial relays with complete production tooling. Since acquisition, we have put together a team which has cataloged the line, prepared new packaging designs, established a complete advertising and direct mailing program and a sales organization, including utilization of the distribution facilities of Alpha Wire. All products have been documented. Here again, we have established a definite written plan. We already are seeing results in sales. Hillburn is participating in a total relay market of $187 million.

We have looked at many potential acquisitions during the past year. We could have completed acquisition deals with many of the companies which we looked at. We are not interested in making acquisitions for a few points in the market. It is our firm policy to make no acquisition unless it will be solid and will add to our present and future. We will not willfully risk present or future dilution. We seek the reverse. We will never buy glamour for glamour's sake. We look for value and growth. We have patience. At this very moment we are looking at a number of interesting situations (one of them Liquidometer Corp).

We are presently 89% military. We would like to attain a 50-50 status. We shall strive in this direction.

Statistics accumulated for the nine months ending Dec. 31, 1960:

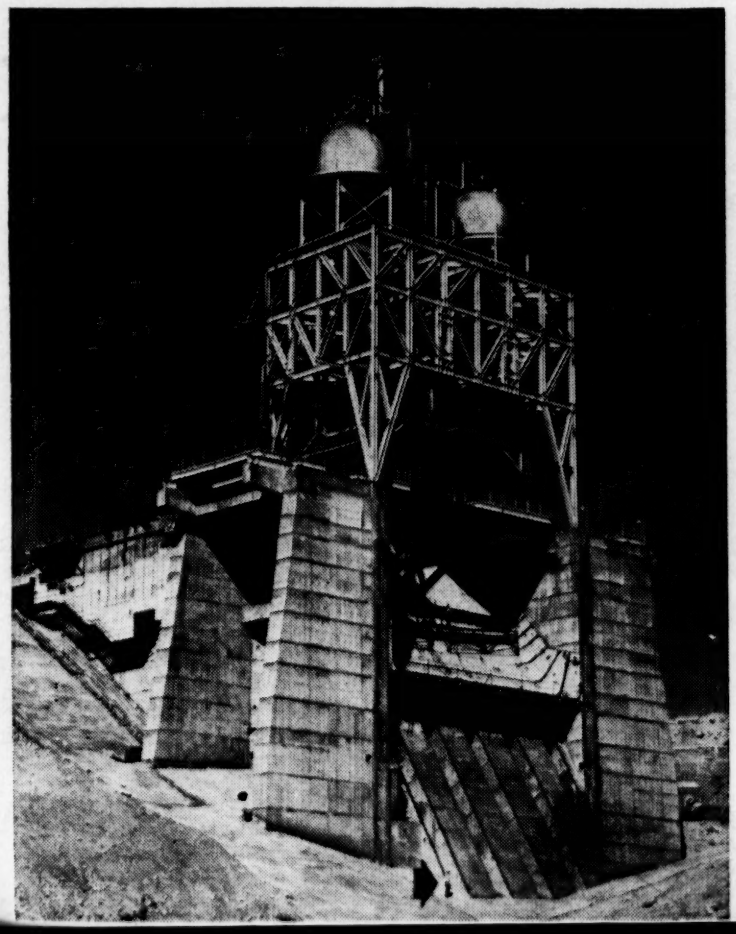
| Comparative Data | 1960 | 1959 |
|---|---|---|
| Current assets | $14,416,000 | $6,807,000 |
| Current liabilities | 4,784,000 | 2,733,000 |
| Net sales | 27,095,000 | 10,553,000 |
| Net income before taxes | 1,981,000 | 778,000 |
| Net income after taxes | 952,000 | 379,000 |
| Net income per share | 54.7 cents | 21.8 cents |
| Current assets to current liabilities | 3-1 | 2.5-1 |
| Turnover of working capital | 2.8 times | 2.6 times |
| Turnover of tangible net worth | 5 times | 2.2 times |
| Net profits to tangible net worth | 17.6% | 7.9% |

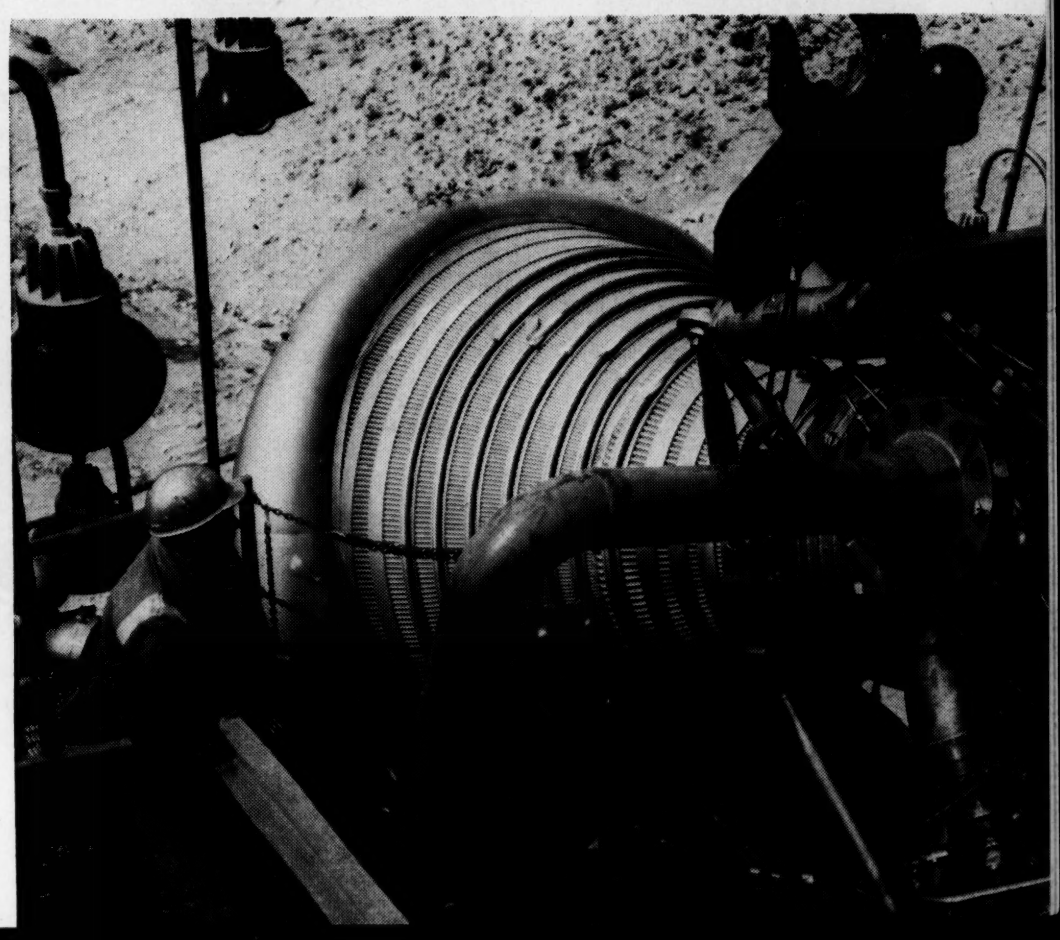
Test Stand 1-B, largest in Leuhman Ridge complex at Edwards Rocket Site, Calif., will test 1.5-million-lb. F-1 rocket engine.

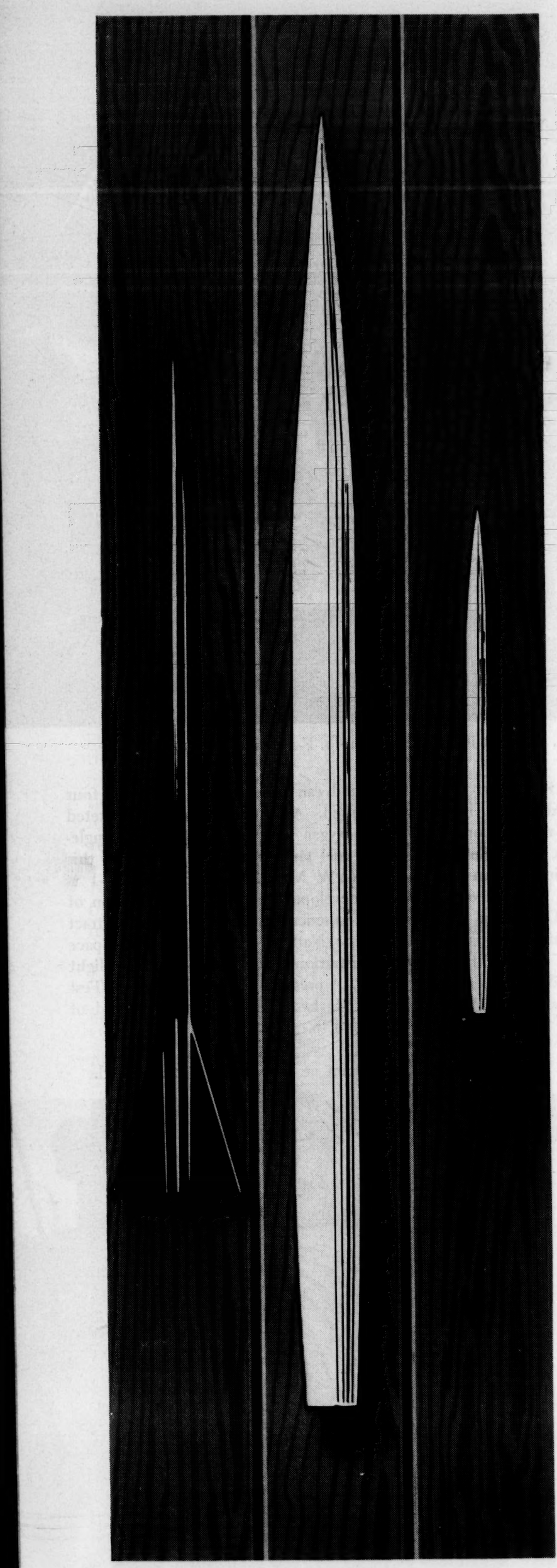
# Tests of Complete F-1 Rocket to Begin Early This Summer

The $15-million Leuhman Ridge test complex for the NASA-Rocketdyne F-1 liquid propellant rocket engine is nearing completion at Edwards Rocket Site, Calif. Tests of the complete F-1 propulsion system will begin early this summer on Test Stand 1-A which was completed in December. Test Stand 1-B, depicted on this page, is the largest in the complex and the last to be completed. It will be used in maximum thrust tests of the F-1. Stand 1-B is 250 ft. tall, can accommodate two of the big engines and can be expanded to handle four if required. A 75,000-gal. vacuum-jacketed liquid oxygen tank and a 60,000-gal. single-walled fuel tank are located on top of this stand (AW Mar. 27, p. 63). The F-1 is being developed by Rocketdyne Division of North American Aviation under a contract from the National Aeronautics and Space Administration Marshall Space Flight Center. A pressure-fed F-1 chamber on Test Stand 2-D has achieved a thrust record of 1,640,000 lb.

Watercooled flame deflector is beneath engine mount on Test Stand 1-B. The F-1 consumes propellant at rate of three tons/second.







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*Aerospace Investment Abroad: Part III*

# Mutual Aid Program Spurs U.S. Industry

By Cecil Brownlow

Geneva—European manufacture of U.S. hardware, whether under straight license agreement, by a subsidiary or by an affiliated firm, often goes far beyond the relatively minor production fee involved in helping prime the pump of major segments of the U.S. aerospace industry.

Orders for actual weapon systems in the initial build-up phases when European production plans cannot meet immediate weapon system needs by a particular country, orders for components, spares, follow-on parts, tooling, etc., all play their part in pushing funds back into the U.S. economy.

This, aside from its obvious political and military role, is one of the major justifications offered by U.S. officials closely connected with the mutual aid program, both in Washington and in Europe.

Mutual aid investments at their best have triggered major equipment orders within the U.S. and, conversely, sparked profitable licensed production of European-developed hardware by domestic American firms. A veteran U.S. official in Paris says flatly that almost any one mutual aid program—as opposed to outright military assistance grants—"will lead to much more business than we are pumping in as aid. The balance of payments will generally wind up with a plus on our side."

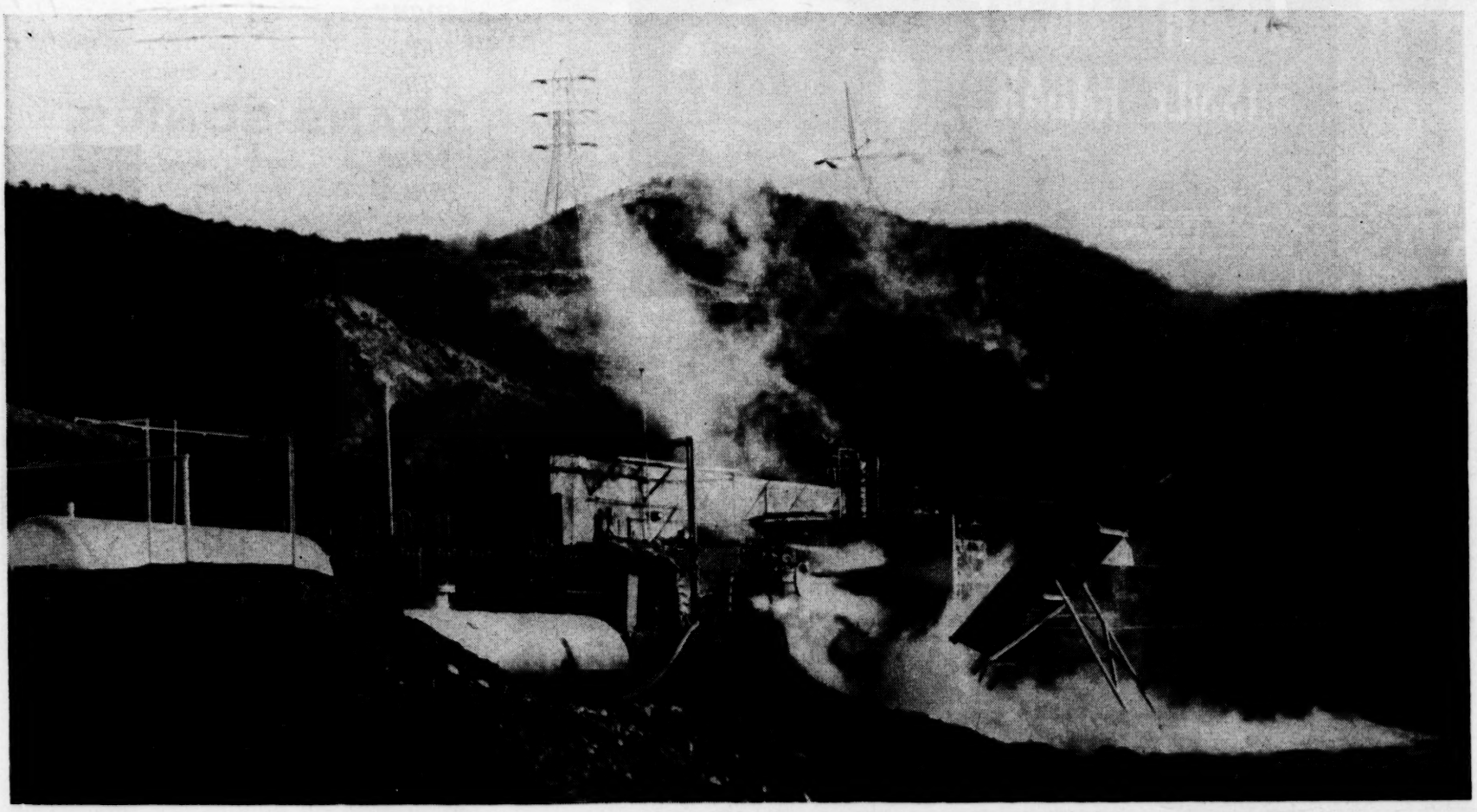
An outstanding example of the benefits that can accrue from such aid—and from foreign production in general—lies in the Lockheed F-104 offshore program as it now stands, where a mutual aid investment of approximately $220 million promises an over-all return of about $1 billion in U.S. business.

The U.S. government, as a spur to induce Belgium, The Netherlands and Italy to join West Germany in the European F-104 production program and modernize their forces at the same time, set aside aid of $140 million for the three countries. Another $80 million is tabled for Japan and its purchase-production plans for approximately 200 aircraft.

Total expenditures in the foreign production program for the F-104 as now established—949 in Europe, 200 in Canada for the Royal Canadian Air Force and 200 in Japan—is estimated by Lockheed at about $2.314 billion, $1.130 billion by Germany alone with 604 of the European aircraft plus 126 purchased directly from the U.S. Almost half of this total will be spent in the U.S. and, but for mutual aid incentives, some of the countries might not have joined in.

The figures do not include any U.S. production that may be forthcoming from plans to provide several nations, including Greece, Turkey and Norway, with the F-104 at little or no cost to the recipients. Although prime, production of these aircraft may go to Canada (AW Apr. 24, p. 27), the U.S. industry should still salvage major component orders.

Mutual aid funds also have played their part in spurring European common production for the Sidewinder and Hawk missile programs, both of which will need support from U.S. suppliers, although probably not on a scale



**Liquid Air Cycle Engine Demonstrated**

Liquid air cycle engine being developed by Marquardt Corp. is demonstrated at the company's Saugus, Calif. test facility. Liquid air is being used as an oxidizer in an 18-in. thrust chamber. Marquardt is working on several methods of liquefying air from the atmosphere to be used as an oxidizer by Aerospace Plane in flights outside the atmosphere.

approaching that of the F-104 program.

Production agreements with individual firms or countries made outside the veil of mutual aid and/or the North Atlantic Treaty Organization also can make an impact, including some that seemingly offer little reward beyond the actual fees involved.

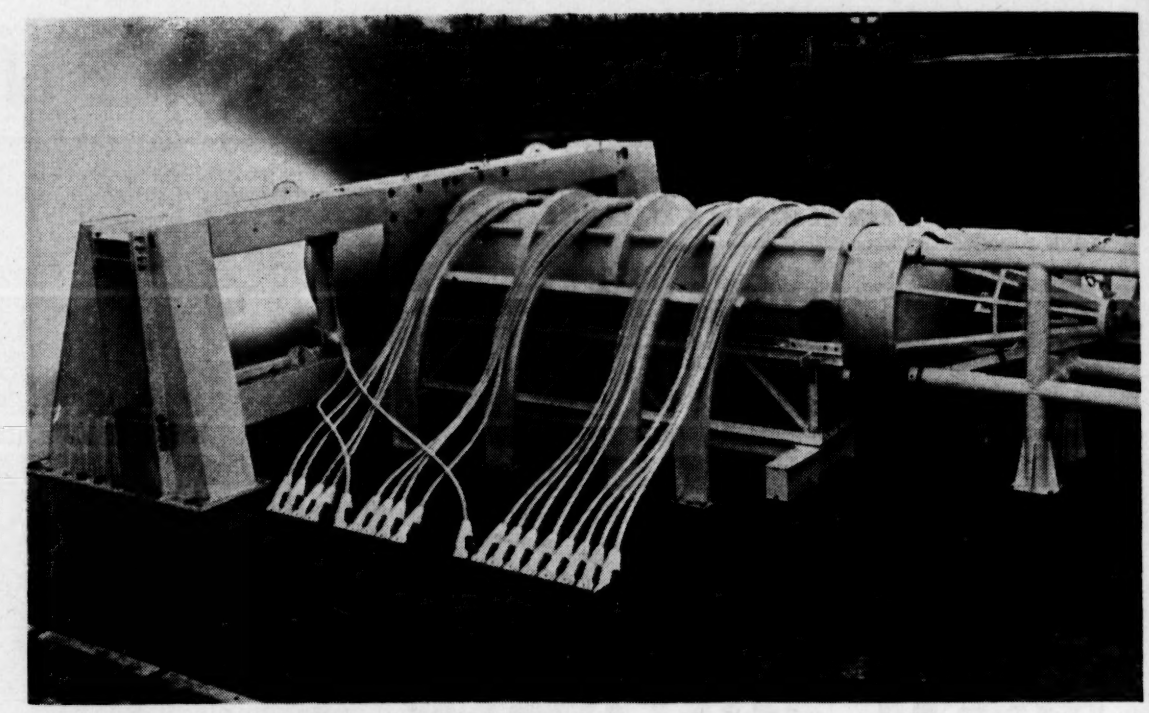
Germany's Weser Flugzeugbau, as an example, is tooling to build two prototypes of the Sikorsky S-64 Flying Crane. If, as expected, sizable German orders for the S-64 follow, United Aircraft will gain considerably through the supply of components, probably including Pratt & Whitney JFTD-12A-1 powerplants, directly from the U. S. Profits from these items should exceed by far the fees and stock dividends United stands to realize from the project—the American firm holds more than 40% of Weser's outstanding stock.

Even the much-disputed Breguet 1150 Atlantic anti-submarine warfare patrol plane program, a NATO-sponsored project involving U. S. mutual weapons development funds, promises return aid to the U. S.

Although at the time the Atlantic was chosen some U. S. airframe companies contended that they were effectively frozen out of the competition in order to assure a European victor, other U. S. firms still stand to profit. Search, identification and detection equipment, for instance, is being ordered in large part from the U. S., and again—mutual aid officials contend—some of the nations now in the program might not have come in had the Breguet borne a "Made in U. S. A." stamp.

Mutual aid participation also gives the American government military production rights to the Breguet, and it may yet be produced in the U. S. if the Navy decides to order it in quantity for its own use.

The NATO ASW competition, however, highlights a sobering fact with which the U. S. industry must contend on an ascending scale, particularly as the European industry regains a more



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A high-ranking Navy officer in Washington, who has followed the program from its inception, declares that "complaints that American firms were frozen out just aren't true. Cost cut them out. We can get the prototypes we need in Europe at a third of the price it would cost us here."

Maj. Gen. C. Stanton Babcock, head of the U. S. Mutual Weapons Development Team (MWDT) headquartered in Paris, agrees. Even in research and development work, Babcock says, "we generally can get what we need for about a third of what it would cost in the U. S."

Babcock cites as an example the Norwegian Terne III anti-submarine weapon system developed with the help of "very little" mutual weapons development funds. The Terne now is being produced for operational evaluation aboard Norwegian and U. S. surface ships. If it lives up to its promise, American manufacturers probably will be called upon to produce it in quantity for Navy use.

The Fiat G.91 lightweight close-support fighter provides another case in point. After its selection by NATO as a common fighter, mutual weapons money was used to support production of the first four prototypes. The aid, as in all such agreements, carried with it recipient rights for the U. S. government to manufacture it in America without fee if it wanted to do so.

Versions of the Italian aircraft are now being evaluated in the U. S. by both the Army and the Air Force. Should either decide on substantial orders, U. S. manufacturers will reap the benefits.

This reverse flow of hardware from Europe to the U. S. is the other side of the coin of the mutual aid programs that are pumping technical know-how and increased profit potential into the European industry as well.

It is a flow, however, that does not always please all the participants, witting or unwitting, as in the case of the Nord SS-11 anti-tank weapon system.

An improved version of the SS-10 developed in part with mutual weapons funding, the SS-11 can be produced at a "cost of well under $1,000," according to MWDT.

"This program," a mutual aid official in Washington says, "is another example of sending over a little and getting a lot back in return.

"We spent less than $5 million on the [development of the] SS-11 compared with $38 million invested in the [Martin] Dart before it was scrubbed when we de-obligated another $23 million.

"The SS-11 has less capability than the Dart, which had hot and cold run-


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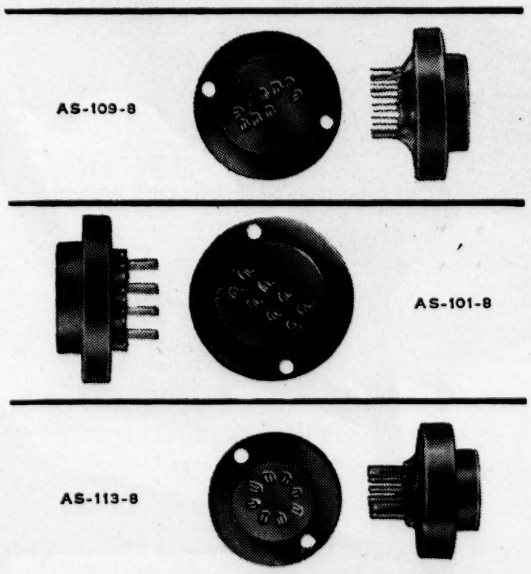


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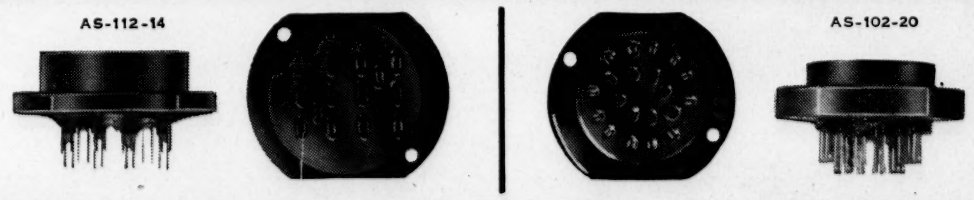


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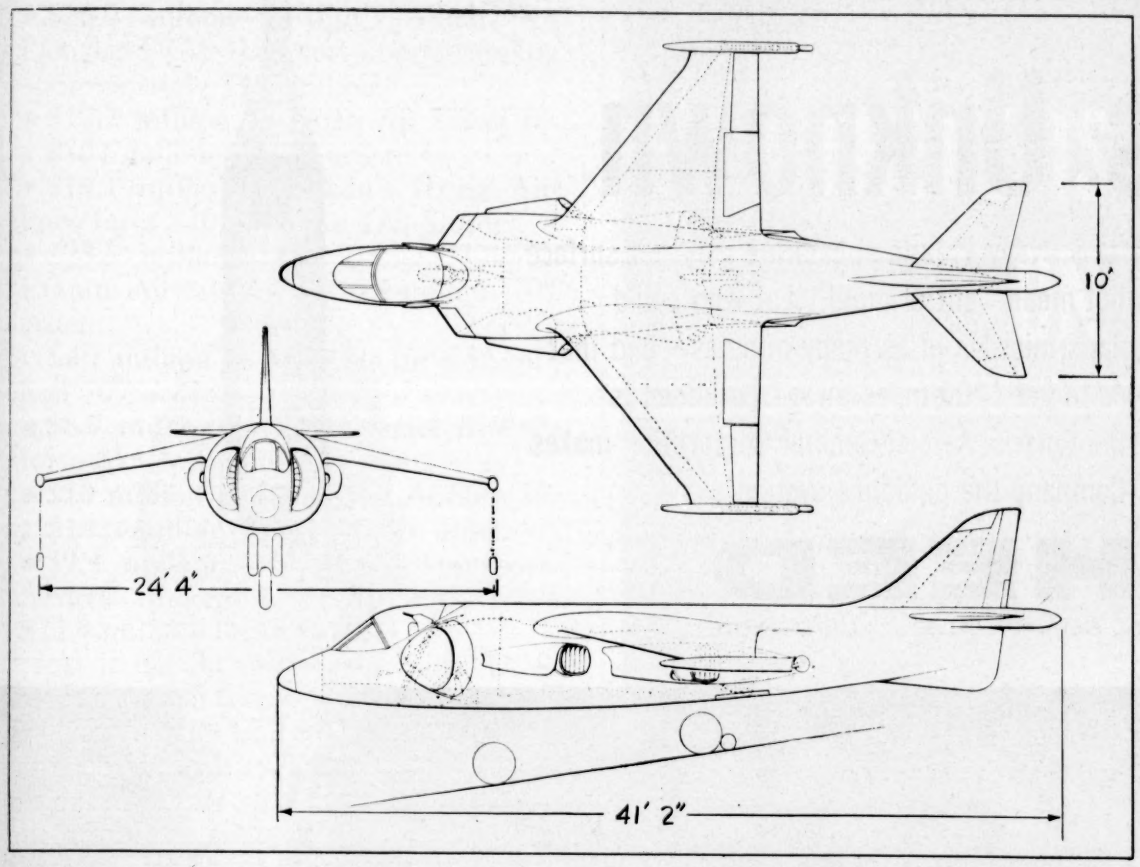



**BRISTOL SIDDELEY BS. 53** turbojet engine powering the Hawker P. 1127 single seat V/STOL aircraft (above) has had $2.6 million appropriated in U. S. funds. In addition to powering the P. 1127 NATO entry, the 15,000 lb. thrust engine will power a Fokker/ Republic Aviation competitor (AW Apr. 24, p. 93).

ning water, but it can do the job, and it's a lot less complicated."

The final result of the aid meant, of course, that the Martin Co. lost a contract, and production hopes, it might otherwise have retained. General Electric, selected to produce the SS-11 in quantity for the Army, gained an order it would not otherwise have had.

Another program in which mutual weapons development funds have been spent that could aid some segments of the U. S. industry to the possible detriment of others is the Bristol Siddeley BS. 53, now powering the Hawker P.1127 VTOL design. The U. S. last June made the decision to appropriate $2.6 million to the BS. 53 project "in order to keep it going," according to a Pentagon official.

"NATO wants a VTOL for close support, and we need a powerplant to put in it," he adds. "There's nothing here comparable to the BS. 53, and that's how we happen to get on this track. . . . And a fair fraction of the money has been spent in the U. S. NASA has done quite a bit of work, tieing it into the European environment."

The BS. 53 is stipulated for two of the entries in the current NATO competition for a V/STOL close-support fighter--a P.1127 follow-on and a design developed by Fokker with Republic Aviation Corp. aid. If either should win and if quantity orders follow, "I'm sure we'd want some of the [BS. 53] production," the official says. He adds:

"We have the same rights as the host government and, if we don't, we don't put any money into it. If we want to produce the BS. 53 for the military, we have the same rights as the British government, but we don't have the rights to produce it for commercial purposes. If we wanted to put it into an airliner, that would be a different problem."

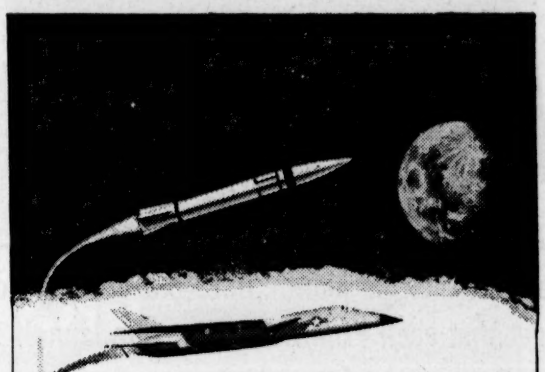
As to the mutual weapons development program as a whole and its relation to the outward dollar flow, the Pentagon official estimates that "over 90% of the total has been spent in the U. S., and I don't think it hurts Ft. Knox very much." The annual MWDT budget has averaged between $35 million and $40 million since its inception seven years ago.

A more outright spur to the industry—with few of the possible pitfalls—has been the government's Export-Import Bank of Washington which has helped finance an estimated 36% of all U. S. transports sold abroad since 1945.

Total Export-Import Bank investments on such loans had reached $326,-217,337 by the end of 1960 on aircraft valued at $536,957,502 and flying the colors of approximately 20 different nations. As an example of the scope of the bank's activity, turbine equipment loans have included:

**$9.52 million to Colombia's** Aerovias Nacionales de Colombia (Avianca) for a $14-million Boeing 720B order.

- **$20 million to Sabena** Belgian World Airlines for a $35.6-million Boeing 707 order.
- **$46 million to Air France** for a $118.3-million 707 order.
- **$5 million to Garuda Indonesian Airways** for a $9.9-million order for three



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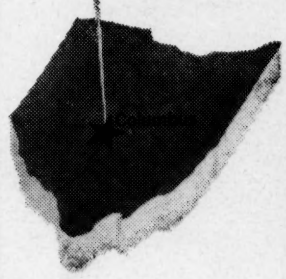

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- **$25.5 million to Australia's** Qantas Empire Airways for a $40.5-million 707 order.
- **$4.1 million to Air-India** for a $6-million 707 order.
- **$8.9 million to El Al Israel** Airlines for a $13.1-million 707 order.
- **$10 million to Ethiopian Airlines** for a $14.6-million Boeing 720B order.
- **$9.4 million to France's** Transports Aeriens Intercontinentaux (TAI) for a $22.9-million DC-8 order.

As it has on the military side, U. S. industry since World War II has taken a commanding lead in the West in the transport field—Aerospace Industries Assn. estimates that 85% of the transports now in use throughout the world are of U. S. design and manufacture.

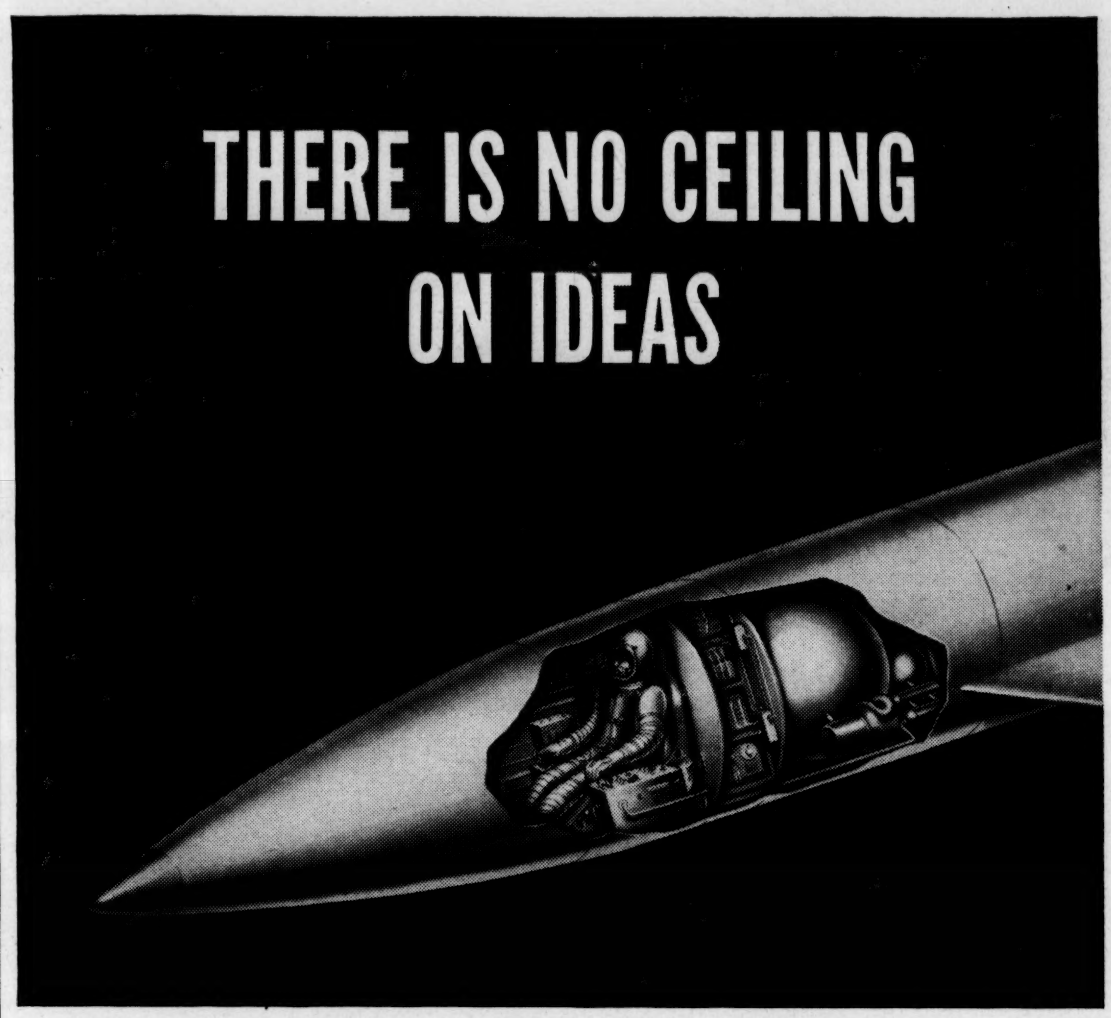
In the future, American industry may face tougher competition in this area also, from East and West, particularly in the area of the supersonic transport. Western Europe has regained much of its strength through U. S. assistance and is ready to compete.

In the field of military aviation, the nations crippled longest by the effects of World War II have relied primarily upon license agreements to regain the strength and technology they needed to survive. Beginning with overhaul and maintenance contracts for U. S. military equipment in the field, the aviation industry of these countries slowly expanded into licensed production of parts and, later, complete systems.

In Italy, Fiat began building the North American F-86. Messerschmitt and Ernst Heinkel Flugzeugbau in Germany tooled up once again to build the Fouga Magister jet trainer under license. SABCA and Fokker in the Lowlands cut their post-war teeth on British designs. Current round is for the F-104 which West Germany predicts will go a long way towards closing the 11-year gap in aerodynamic and powerplant technology suffered after World War II, the Breguet Atlantic and the Nord Transall C. 160 turboprop transport common production programs.

Need for more funds, facilities and technical know-how than any one country possesses is drawing the countries closer together despite the political squabbles of their leaders. Germany, as an example, has development pacts with its Common Market partners and with the competing Outer-Seven.

European industry is still looking toward the U. S., but the U. S., in turn, is looking more and more toward Europe.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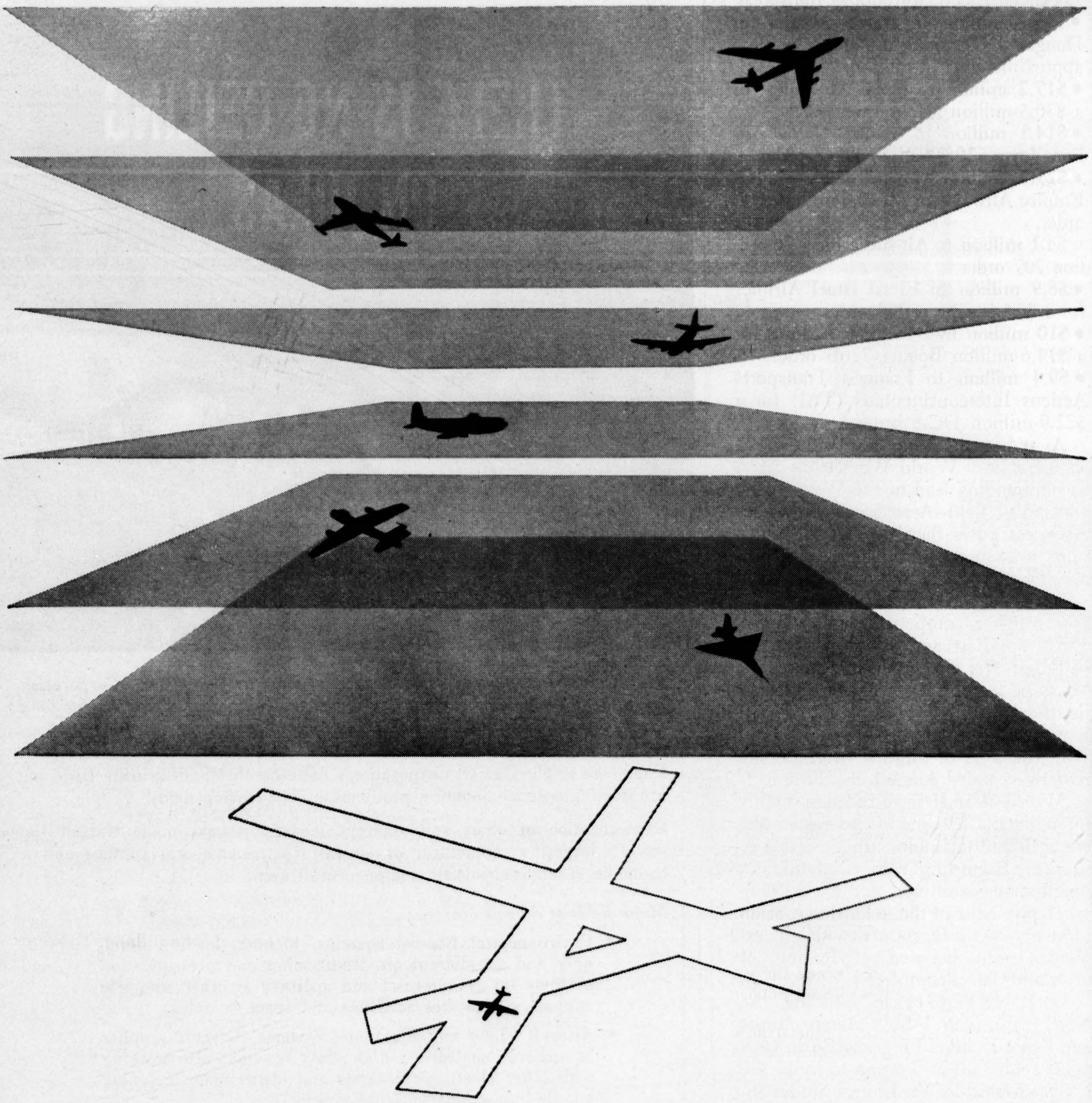
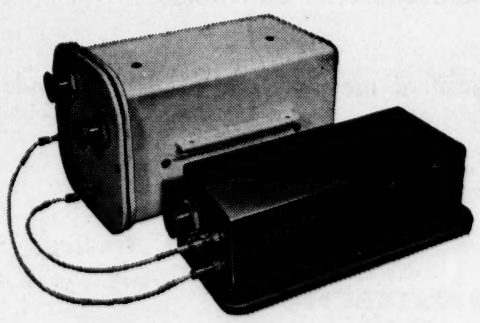


# Cubic MOPTAR—key to jet age collision avoidance



MOPTAR requires only this miniature transponder in each participating aircraft.

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# WHO'S WHERE

(*Continued from page 23*)

## Honors and Elections

**Gerald J. Lynch,** vice president of Ford Motor Co.'s Defense Products Group and general manager of the company's Aeronutronic Division, has been named Southern California Regional Vice President for the National Security Industrial Assn.

**Dr. Donald B. Mackay** of North American Aviation's Space and Information Systems Division has received the Society of Automotive Engineers' Manly Memorial Medal for presenting 1960's best paper involving aerospace engine systems.

**Col. Carlin H. Whitesell,** director of Titan I construction for the Corps of Engineers Ballistic Missile Construction Office, Los Angeles, Calif., has been named the recipient of the Society of American Military Engineers' Wheeler Medal for his "supervision and administration of construction of essential defense installations . . ."

## Changes

**Dr. Vincent Berinati,** technical assistant to the director (Washington, D. C.), Aerospace Corp., Los Angeles, Calif.

**Gordon B. Knoob,** staff engineer, Program Planning Department, Western Center of Motorola's Military Electronics Division, Scottsdale, Ariz.

**Henry M. Stewart,** director of marketing, Air Associates, Inc., Teterboro, N. J.

**Robert G. Day,** manager of the newly formed Scanner Systems Group, Gulton Industries, Inc., Metuchen, N. J.

**Arthur H. Wolfson,** engineering proposals manager, Data Systems Operations, Sylvania Electric Products, Inc., Needham, Mass.

**D. W. Kreybill,** project manager-Saturn, Astronautics Division, Chance Vought Corp., Dallas, Tex.

**Dr. Clayton F. Black** has joined the systems research staff of the Bissett-Berman Corp., Los Angeles, Calif.

**Stuart M. Hauser,** assistant general manager for operations, Electro-Optical Instruments, Inc., Pasadena, Calif.

**Thomas N. Kasabali,** general manager, Universal Research & Testing Laboratories, Glendale, Calif., a division of Idaho Maryland Industries, Inc.

**Palmer Derby,** marketing manager, Microwave and Power Tube Division of Raytheon Co., Lexington, Mass., succeeding **George C. Trotter,** appointed to the newly created corporate post of consultant, microwave components.

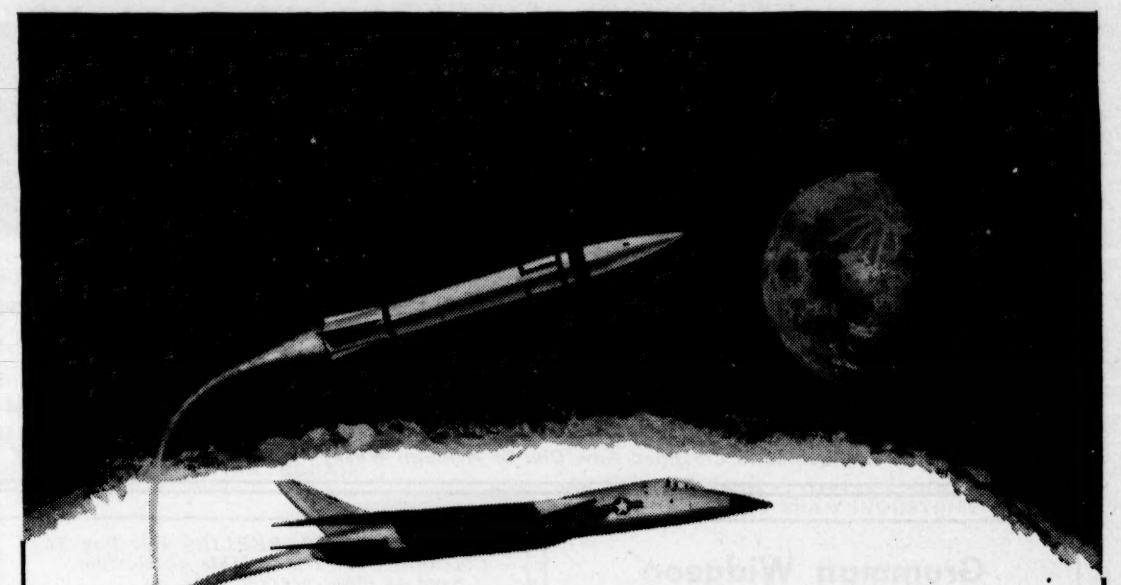
**Robert L. McGrath,** manager-production control, General Dynamics/Electronics' Military Products Division, Rochester, N. Y.

**Prof. Carl Olen,** staff consultant-electronic communications, Aero Geo Astro Corp., Alexandria, Va.

**John S. Luce,** special assistant to the head of the Nucleonics Research and Development Division of Aerojet-General Corp., Azusa, Calif.

**Oliver Hopkins** and **Jerome Pohlen,** rotary-wing sales specialists, Cessna Aircraft Co., Wichita, Kan.

**Malcolm C. Tucker,** Eastern regional manager (Washington, D. C.) for Telecomputing Corp., Los Angeles, Calif.

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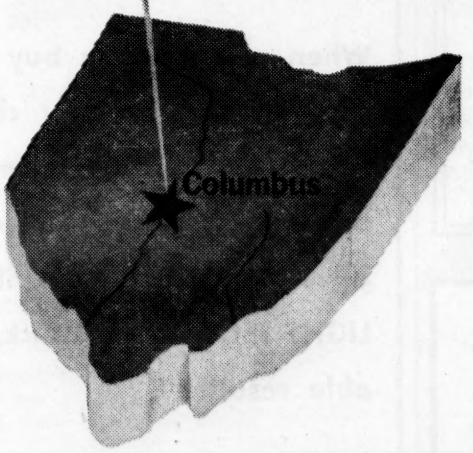


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# LETTERS

## U.S.-Philippine Pact

I have read and reread your editorial in the Jan. 2 issue of AVIATION WEEK. I certainly hope and wish that more men who have to make decisions regarding the penetration of communism will have the opportunity of reading your editorial as I believe that it has many thoughts to offer. In support of some of the points that were brought out in your editorial, I would like to mention a few facts.

1. For our rural areas [the Philippines], we have found no proper solution in the way of aircraft. We have operated the Canadian de Havilland Otter and found it wanting. We are flying the Scottish Aviation Twin Pioneer and it has fared poorly from an economic standpoint. We are still operating the DC-3s and have felt that the F-27 has provided a substitute in certain situations, but there is still an area into which only the DC-3 provides economic commercial operation because of undeveloped airstrips. In the other routes, we have been successful in introducing British Vickers Viscounts which routes were pioneered by the Convair 340. We have operated the Hiller helicopter and again found poor commercial application.

2. We find that we are sorely in need of new and better equipment, but our problem is not studied by the technical people of the United States because our problems are not similar or applicable with regards to the domestic problems in the United States. We, therefore, have found that in spite of ourselves, we must look to other areas for possible solutions to our aviation problems.

3. The termination of the bilateral agreement between the United States and the Philippines is further indication of the apparent cleavage that is being created between the United States and Philippine aviation. I, therefore, heartily endorse your recommendation that there be a re-evaluation of the United States program.

We in the Philippines believe that there is an immense reservoir of goodwill toward the United States especially in the aviation field. We do find, however, that we must get the United States to see and recognize our problems with the view to arriving at solutions that will be of mutual benefit to both countries.

Our own review of the Philippine-U. S. bilateral indicates that the first bilateral signed in 1947 was acceptable to the Philippines at the time when the U. S. was so dominant in the aviation picture and we had just acquired our independence. Over the years the Philippines has developed its own viewpoint, and felt that the original bilateral was too one-sided and as Philippine national identification grew we felt that a more mutually considerate bilateral agreement should be arrived at. Naturally, such a bilateral would have distributed its advantages more equitably and, therefore, would result in a bilateral less one-sided. This has resulted in an impasse which seems unnecessary, considering the actual and real friendship between the United States and the Philippines.

***Aviation Week welcomes the opinions of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 330 W. 42nd St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.***

If we are going to be considered the real friends that we are, it is our considered opinion that America must understand our point of view; that we must be treated no less than those who were enemies and who have recently become friends. We are resolute in our feelings and conviction that we are friends, that we have been friends and will always be friends.

I may have digressed from the point which I originally intended to write to you about, and that is: I concur fully that the thin edge of the wedge is an actual and real situation, one that merits thought and action, for if the free nations do not take advantage of their established goodwill then the Soviets can do so and do so at their own full advantage.

ROBERTO LIM
Vice President
Philippine Air Lines
Manila, Philippines

## 727 Details

The article entitled "Boeing Reveals Final 727 Design Details" by William S. Reed (AW Mar. 6, p. 60), carefully explains why some of the features of the Vickers VC. 10 and Caravelle were considered and rejected.

However, no mention was made of the de Havilland DH 121. This would have been a most interesting comparison since, superficially at least, the proposed 727 seems to be mainly a slightly enlarged version of the DH 121.

CLIVE S. LISTON
Mountain View, Calif.

## Interservice Rivalry

Reference your issue of Apr. 17 (p. 160):

In the interest of contributing to the further increase of interservice rivalry in humor, may I add how surprised and pleased I am to see the honest and factual representation of the TAC-Air Force concept of ground support for the Army. Such keen perception of the Army's need reflects the usual high standards our brothers in light blue strive to maintain in order to insure that we get the best—even before SAC! I am surprised, though, that the Air Force salvaged their pride to the extent that they are willing to import French aircraft and admit that ARDC could not come up with something just as good after trying since 1917.

Viva TAC and Rip Van Winkle.

(Name withheld by request.)

ARMY PENTAGON WARRIOR
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## First No More

The Russian triumph in space points out a fact that becomes more obvious all the time. America is no longer the land of "firsts."

Until Oct. 4, 1957, the eyes of common men everywhere were fixed on America as the technological leader of the world. Then came Sputnik I, which fired the imaginations of men as nothing had since the Wright brothers. The world then looked to Russia as the new leader in technology. In rapid succession came repeated Russian "firsts": a solar satellite, a lunar impact, a circumlunar vehicle which photographed the unknown far side of the moon, animals almost routinely recovered from orbit, a piggyback launch of a Venus probe, and on Apr. 12, 1961, the most spectacular of all, manned orbital flight.

Without doubt, the Kremlin deliberately has selected space as the area to demonstrate to the world the technological leadership of Soviet society.

Space is the area of high adventure and pioneering that thrills men today as Marco Polo, Columbus, and Lindbergh thrilled men yesterday.

America has been first in war, first in peace, first in political, industrial and scientific leadership, and first in the hopes and minds of men for almost two centuries. Now, because of carefully planned and fully exploited triumphs by Russia in space, America is a lackluster second in the eyes of the common men of the world.

We must realize that there is a technological war in addition to the cold war. The nation whose accomplishments demonstrate technological leadership is looked up to by Africans, Asians, Europeans and South Americans. America may be first in wage scales, living standards, life span, miniaturization, medical research, entertainment, leisure time and shopping centers, but these mean nothing to billions of people whose cultures in no way resemble ours. These billions can grasp the reality of age old dreams of soaring in space and exploring the moon and planets.

These achievements are tangible to all men. The nation to achieve them leads the minds of all men.

We can look forward almost inevitably to the next easily predictable Russian firsts: a multi-man orbiting vehicle, a manned space station, manned flight around the moon, a manned landing on the moon, a manned lunar colony, and manned exploration of the planets. In addition to these space achievements, Russia almost certainly will be years ahead of us in producing a nuclear-powered aircraft and a Mach 3 commercial airliner.

Must America continue to be second? Must America, by lack of imagination and drive, deliver by default the minds of men to the Kremlin? Are we incapable of shaking off our complacent lethargy and using our funds and know-how on a concerted, long-range basis to re-establish our fine tradition of being first?

CALVIN C. CHAPMAN, M. D.
San Antonio, Tex.